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RESEARCHES ON THE ELECTRO-DEPOSITION OF CHROMIUM.

By PROF. OSVALDO MACCHIA.

The first mention of the electro-deposition of chromium is in the brief note of A. Bartoli and G. Papasogli[1]. The writers say that the chromium was deposited by reduction of the chromium chromate formed during electrolysis. F. Salzer[2] thought that the chromium-chromate formed during electrolysis is the compound which helps the electro-deposition of metal. Later R. Carveth and E. Curry[3] according to their experiments considered it was most probable that " in the solution of chromic acid exist a number of hexavalent chromium cations in equilibrium with many other ions." Besides, according to the same writers, it was probable that the real acids and salts " help the increased dissociation of *chromic acid to hexavalent chromium* ions " and the deposition of chromium at the cathode may come directly from those ions.

Sargeant[4] for the first time gave an explanation of the electro-deposition of chromium. This author stated that the separation of the chromium from the solution of chromic acid containing SO_4 ions " seems to be first the acid solution in contact with the cathode. The formation of a film on the cathode is almost always accompanied with a sudden increase in the voltage and by a sudden evolution of hydrogen at the cathode." This writer had also observed that during the electrolysis of the solutions of chromic acid trivalent chromium ions are formed. It therefore induced him to add to the bath SO_4 ions in the form of chromium sulphate rather than as sulphuric acid. He then concluded contrarily to Carveth and Curry that hexavalent chromium ions are not reduced directly to metallic chromium. Liebreich[5] communicated a similar view almost at the same time in theoretical contribution. The only difference was in the different breaks observed in the cathode current density and cathode potential curves. Sargent[6] observed only one

[1] *Gazz. Chim. Ital.*, 1883, *13*, 47; see also O. Macchia, *Ind. Chim.*, 1930, *5*, 150.

[2] D.R.P.n 221472 (26 Apr. 1910); and D.R.P.n. 225769 (20 Sept., 1910).

[3] *J. Phys. Chem.*, 1905, *9*, 353.

[4] *Trans. Am. Electrochem. Soc.*, 1920, *37*, 479.

[5] *Z. f. Elektrochem.*, 1921, *27*, 94.

[6] *Loc. cit.*

break, Liebreich[7], on the contrary, found three distinct breaks. Later, A. Kieffer[8] and K. Oyabu[9] did not obtain different breaks from those found by Liebreich in the cathode potential current density curve, but it depended on their having used solutions of chromic acid which were not pure[10]. Recently V. Kato and T. Murakami[11] studied the formation of the breaks basing their experiences in the concentration of the hydrogen which is formed at the cathode. Liebreich had also observed that as an effect of the reduction of the hexavalent chromium ions at the cathode, chromium oxide and hydrovide colloids are formed. These substances should form around the cathode as a film which should be reduced subsequently to bivalent chromium ions which should then be transformed into chromium[12]. The presence of those oxides at the cathode has been also shown by V. Schischkin and H. Gernet[13]. Liebreich admitted also that the presence of chromium ions is necessary for the separation of chromium at the cathode and the presence of SO_4 ions[14] only had the object of facilitating this separation. Recently, E. Liebreich and V. Duffek[15] have observed that chromium electro-deposition from solutions of pure chromic acid is only produced by a very strong current density and with very poor efficiency. The metal deposited always contains a notable quantity of oxides[16]. E. Müller[17] says that the formation of metallic chromium at the cathode is obtained directly with chromic acid not dissociated from a film of chromium dichromate or chromium oxides. In the presence of SO_4 ions this diaphragm is damaged and reduction takes place. S. Lukens[18] later advanced a theory similar to that of Müller, by which the electro-deposition of chromium is produced directly from hexavalent chromium ions. E. Liebreich[19] did not accept the views of Müller and it has been the subject of a polemic[20]. G. Fink[21] considers that the SO_4 ions are the catalysts of the solution of chromic acid. Y. Kato, T. Murakami, S. Saito[22] suppose that CrO_3 is first reduced to $Cr(OH)_3$. This should form a film around the cathode which should then be reduced with hydrogen and we should so have the chromium electro-deposition. These writers also state that the cathode film can not be formed by chromium dichromate, because the last one does not exist in colloidal solution. V. Kato and T. Murakami[23] studying the quantity of hydrogen and the quantity of chromium which is formed at the cathode under various current densities state that the chromium electro-deposition of solutions of chromic acid does not come from the reduction of the chromate ions, but by the effect of the cathodic reduction of the film formed with chromium oxide, by means of hydrogen. R. Scheidewind[24] is unable to confirm the formation of the film of solid or colloidal chromium hydroxide or a similar substance, or even hydrogen. This author starting from the basis of heat transfer and fluid flow, states that there is in contact with the cathode during electrolysis, a film of solution whose composition is different from that in the main body of the bath. R. Scheidewind does not exclude the possibility that during electrolysis may be formed from solid or colloidal, chromium hydroxide or oxide, but they may be formed by other reactions and so they would not be the real cause of the chromium electro-deposition.

From what has been written it is easy to note a dissension among the different theories which have been presented, never-the less almost all the authors are unanimous in admitting the formation at the cathode of a solid or colloidal film of hydroxide or oxide. The aim of the present researches was to prove experimentally the txistence of the film at the cathode and to expound better the phenomena which ap-

[7] Loc. cit.
[8] Z. f. Elektrochem., 1928, 29, 488.
[9] Z. f. Elektrochem., 1923, 29, 491.
[10] Z. f. Elektrochem., 1924, 30, 186.
[11] Chem. News, 1928, 132, 328.
[12] Z. f. Elektrochem., 1923, 29, 208.
[13] Z. f. Elektrochem., 1928, 34, 57.
[14] Oberflächentechnik, 1928, 5, 105.
[15] Ber., 1929, 62, 2527.
[16] Those experiences were given already by R. Scheidewind, Bull Eng. Res. n. 10, 1928, Univ. Michigan.
[17] Z. f. Elektrochem., 1926, 32, 899; 1927, 33, 72.
[18] Trans. Amer. Electrochem. Soc., 1928, 53.
[19] Z. f. Elektrochem., 1927, 33, 69.
[20] Z. f. Elektrochem., 1927, 33, 72.
[21] U.S. P. 1581188 (1928).
[22] J. Soc. Chem. Ind., Japan, 1928, 31, 128.
[23] J. Soc. Chem. Ind., Japan, 1928, 31, 124.
[24] Loc. cit., page 22.

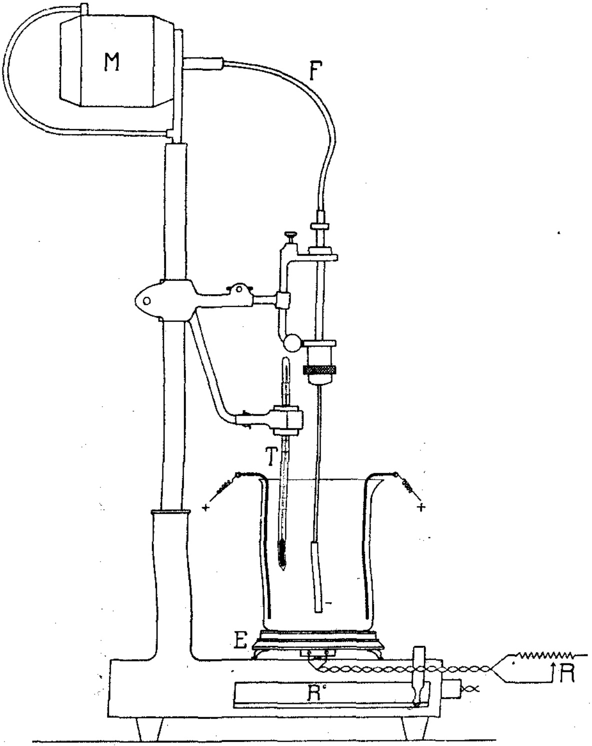
pear during the chromium electro-deopsition. At present the existence of the film at the cathode is based upon the observation mentioned by Müller[25] and G. Grube and H. Burkhart[26]. It is possible to prevent entirely the cathodic reduction of the alkali hypochlorites, if a small quantity of potassium chromate has been dissolved in the solution, therefore the chromate must be reduced at the cathode by the effect of the electrolysis and the Cr ions which are formed, reacting with the CrO_4 ions give origin to a basic chromium chromate which is less soluble. The same substance should cover the cathode with a thin film and should prevent the ClO ions being reduced. Müller uses this phenomenon to confirm the formation of a film at the cathode.

In the various experiments made results have been obtained in the first part which afford some proof of the variation of the thickness of the cathodic film and in the second part the relation existing between the quantity of the SO_4 ion present in the chromium plating baths and the thickness of the film.

Experimental Part.

The earlier experiments were based upon the observations made already by Carveth and Mott[27] and by Schisshkin and Gernet[28] that when the cathode is maintained in rotation during electrolysis it is possible to obtain, using very high current density a bright deposit. When the cathode is held firm using the same high current density, the deposit becomes oxidised. To explain this phenomenon and to make a series of proofs given in Table I, I used the apparatus shown by the figure. The solution used (about 500 cc.) was formed by 250 gr. of CrO_3 and 2.5 gr. l of H_2SO_4 and it was contained in an 800 cc. beaker. It was put on an electric heater (E) directed by a suitable rheostat (R). The solution temperature was controlled by the theomometer (T). The anode was formed by a sheet of lead (containing 6 per cent of antimony) of thickness 2mm. and 13 cm. high, put all around the beaker. The cathode consisted of a cylindrical copper rod of 6 cm. length and 0.5 cm. diameter. By a copper rod of 2 mm. diameter welded in the centre of the circular section of the cylinder, this was hung in the bath and was fixed to the conjunction of transmission of the thread (F). In this way the cylinder forming the cathode could, by the transmission (F) worked by the motor (M), be put in rotation. The velocity of rotation was controlled within the possible limits, by a convenient rheostat (R). The measure of the current used was given by the voltmeter and by an ammeter. The experiments have confirmed the theory of the formation of a cathodic film during chromium electrodeposition. Using a current density of 12 amp. per sq. cm. when the bath temperature is 25° C., if the cathode is maintained fixed, the deposit becomes oxidised, while if on the contrary, it is put in movement during electrolysis, the deposit becomes bright. Besides, it has been observed that if the velocity of rotation does not take a considerable value (*i.e.*, not more than about a hundred revolutions per minute for the above current density and temperature) the deposit becomes less bright. For instance, if the velocity of rotation is 220 revolutions per minute the deposit becomes bright and as the rotation velocity diminishes, the deposit becomes duller (see Table I). We must admit then that the thickness of the film around the cathode is not uniform, but increases with increasing current density. About this we shall speak more in the second part of the experiments. By working, for instance, with a current density of 5 amp. per sq. cm. at 25° C., a bright deposit can be obtained, otherwise, using a current density of 12 amp. the deposit is oxidised. It is necessary, then, to admit that in this last case the thickness of the cathodic film of hydrogen or of chromium oxide or hydroxide, solid or colloidal, is different and thicker, since the discharge of chromium ions is not obtained in such a manner to give a bright deposit. Confirmation that the film cannot have a uniform thickness is shown by the experiments summarised in Table I. Indeed, when the cathode is maintained at a convenient rotation during electrolysis, it is possible to have a bright deposit of chromium with current density higher than those commonly used, because by the effect of centrifugal strength the cathodic film tends to diminish and then the discharge of chromium ions occurs in a regular manner, even with a high current density. By diminishing the velocity of rotation of the cathode the consequent centrifugal strength diminishes also, and the cathodic film becomes thinner and the discharge of the chromium ions becomes regular even with high current density. By diminishing the rotation velocity of the cathode the conse-

[25] *Loc. cit.*
[26] *Chem. and Met. Eng.*, 1924, *30*, 639.
[27] *J. Phys. Chem.*, 1905 *9*, 231.
[28] *Loc. cit.*



quent centrifugal strength diminishes and the thickness of the film tends to increase and therefore the discharge of chromium ions is such that the deposit of the chromium is rough and dull. The deposit is less bright according as the rotation velocity is less. From these experiments it is found that the thickness of the film is not uniform and increases with increasing current density. In order to explain also the phenomenon observed earlier by W. Pfanhauser[30] and attributed by T. Taylor[31] to the bath or the cathode being maintained in motion during electrolysis, the deposit formed is frosty, we can admit that the agitation or motion prevent the regular formation of the film around the cathode so as to obtain a bright chromium deposit. In Table I the bath composition was 250 gr. l. CrO_3 and 2.5 gr. l. H_2SO_4.

The second part of the experiments aimed at establishing the relation between the quantity of the SO_4 ions present in the chromium plating bath and the thickness of the film. It is known that in order to obtain a bright chromium deposit, it is necessary that the ratio of chromic ions to sulphate ions[32] or of chromate to sulphate[33]

TABLE I.

Temp. °C.	Current density amp.	Revs. per min.	Deposit
25	12	50	Burnt
25	12	100	Frosty
25	12	125	Frosty
25	12	150	Bright
40	30	50	Burnt
40	30	100	Frosty
40	30	125	Frosty
40	30	150	Bright
50	70	50	Burnt
50	70	100	Frosty
50	70	125	Frosty
50	70	150	Bright

may be very often as high as 50 or 100. It is known that by increasing the quantity of sulphate ions whilst keeping the temeprature, the current density and the concentration of chromic acid constant, the deposit tends to become frosty. Some authors have overlooked this, and for a further explanation of it we may refer to the studies of E. Haring and P. Barrows[34] and R. Scheidewind[35].

V. Schischkin and G. Gernet[36] have noted that at a low temperature (25° C.) it is possible to obtain bright chromium deposits, using high current density and a considerable amount of sulphate ions. In order to study the relation between the quantity of the sulphate in relation to the cathodic film when the electrode did not rotate, I used the same apparatus illustrated by Fig. 1, but without the motor necessary to maintain the cathode in movement. Experiments were first made by maintaining temperature and current density constant and by changing the quantity of SO_4 ions. These were added to the solution as H^2SO_4 and in convenient quantity. For this purpose exactly normal and decinormal acid solutions were used. The results of different exepriments at low temperature are given in Table II. By these we see that with a current density of 10 amp. per sq. cm. it is not possible to obtain a deposit bright enough till the ratio, chromic acid/sulphuric acid reaches 45 and 38 gr. CrO_3 and 5.5 and 6.5 H_2SO_4 per litre (see Table II). Likewise for a bath containing the same quantity of CrO_3 per litre at 25° C., using a current density of 8.2 amp., it is only possible to obtain a bright chromium deposit when the concentration of sulphuric acid reaches 4 and 5.5 gr. H_2SO_4 per litre and the consequent ratios become 62 and 45. Likewise, using a current densitv of 6 amp. it is possible to obtain a bright chromium deposit at 25° C. if the quantity of H_2SO_4 is below 1.5 gr. per litre (ratio=166). The result of various experiments made at 25° C. are presented in the following table :—

TABLE II.

D.	Gr. H_2SO_4 per l.	CrO_3 present 250 gr. per litre ratio	Appearance
10	4	62	Frosty
10	4.5	55	Frosty
10	5	50	Frosty
10	5.5	45	Bright
10	6	41	Bright
10	6.5	38	Bright
10	7	34	Frosty
8	3.5	71	Frosty
8	4	62	Bright
8	4.5	55	Bright
8	5	50	Bright
8	5.5	45	Bright
8	6	41	Frosty
8	6.5	38	Frosty
6	1.25	200	Frosty
6	1.4	178	Frosty
6	1.5	166	Bright
6	1.75	147	Bright+
6	2	125	Bright++
3.8	4.5	55	Frosty
3.8	4	62	Frosty
3.8	3.5	71	Bright
3.8	3	83	Bright+
3.8	2.75	90	Bright++

It is evident that the thickness of the cathodic film is almost constant when temperature, composition of the bath and current density are maintained constant. Already G. Fink[37] and E. Müller[38] have communicated that the SO_4 ions must have a specific action on the cathodic film and later on Scheidewind studied the effect produced by varying quantities of SO_4 in relation with the appearance of the chromium deposit. Now considering the case in which a current density of 10 amps. is used as with a quantity of H_2SO_4 greater than 6.5 gr. per litre or less than 5.5 gr. per litre a chromium deposit more frosty can

[30] Le Chromage Electrolytique, page 29. Beranger edit. Paris (1928).
[31] *Amer. Machinist*, 1929, *71*, 137.
[32] R. Scheidewind, *loc. cit.*, p. 24.
[33] E. Harig and P. Barrows, *Tech Pap., Bur. Standards*, 346.
[34] *Loc. cit.*
[35] *Loc. cit.*
[36] *Loc. cit.*
[37] *Loc. cit.*
[38] *Loc. cit.*

be obtained according to the quantity of H_2SO_4 within the above limits, the reactions between the cathodic film and the SO_4 are produced in a manner to produce a reduction of the chromium ions, and thus a bright deposit at the cathode. If the quantity of SO_4 ions is greater, the film adsorbs some of the SO_4 ions, if their quantity is less, it is insufficient to produce the reactions necessary to produce a bright chromium deposit Using for the same bath at the same temperature a current density of 3.8 amps. it is impossible to obtain a bright chromium deposit when the quantity of H_3SO_4 is greater than 3.5 gr. per litre, but if we increase the current density to 6-8 amps, maintaining the quantity of H_2SO_4 constant, the deposit becomes bright. The explanation of the phenomenon is clear, admitting the variation of the cathodic film. The formation of the dull deposit is obtained by a current density of 3.8 amps, when the concentration of H_2SO_4 is about 4.50 gr. per litre, and depends upon the small thickness of the cathodic film in relation to the greater qnantity of SO_4 ions which come into contact with it during electrolysis. Indeed, increasing the current density to about 7 amps, the deposit remains bright, because the thickness of the film increases and then the relations between it and the SO_3 ions are such as to produce a bright chromium deposit. The same thing can be said when the quantity of SO_4 ions diminishes. Indeed with a current density of about 6 amps we have a bright chromium deposit when using the same bath and the same temperature, whilst the concentration of the H_2SO_4 is below 1.40 gr. per litre ($CrO_3/H_2SO_4 =$ 178). If the concentration of the SO_4 ions diminishes, then the deposit formed is duller consequent upon the diminution of the amount of SO_4 ions. It depends upon the insufficient quantity of the SO_4 ions which come into contact with the cathodic film give rise to the reactions by which a frosty cathodic deposit is formed. By diminishing the current density and therefore diminishing the thickness of cathodic film it is possible to obtain a bright chromium deposit, so that if the current density is reduced at 4 amps we have a bright plate with a concentration of H_2SO_4 equal to 1.25 gr. per litre ($CrO_3/H_2SO_4 = 200$), of course the relations between the thickness of cathodic film is between the current density used and the quantity of SO_4 ions present in a bath of that concentration of CrO_3 at the given temperature. In a final series of experiments the relations between the thickness of the cathodic film and the temperature were studied.

For a bath containing 250 gr. per litre of CrO_3, if it is carried out at the temperature of 25° C. with a current density of 6 amps. with a concentration of SO_4 ions 1.40 gr. per litre ($CrO_3/H_2SO_4 = 178$) we may obtain a frosty deposit. On the other hand by elevating the temperature to 40° C. the deposit always becomes more bright. The phenomenon can be explained in the following way. At the temperature of 25° C., the chromium deposit is frosty because the thickness of the film is too great in comparison with the quantity of SO_4 ions which come in contact with it, and if we increase the quantity of the latter (maintaining unchanged, of course, the thickness of the film, *i.e.*, the current density) to about 1.50 gr. H_2SO_4 per litre ($CrO_3/H_2SO_4 = 166$) a bright deposit results. Now if the quantity of SO_4 ions remains invariable when the bath is brought to a temperature of 40° C. and the deposit consequently becomes bright it is clear that we must infer that the thickness of the cathodic film has diminished so that the relations between the film and the SO_4 ions are produced in such a manner to give a bright chromium deposit on the cathode. At 25° C. using a current density of 8 amps, with a concentration of SO_4 ions equal to 1.40 gr. H_2SO_4 per litre ($CrO_3/H_2SO_4 = 178$) the deposit becomes oxidised, because the quantity of SO_4 ions is insufficient in comparison with the thickness of the film[39] but if we increase the temperature to 40° C. a bright deposit results. The brightness of the deposit depends on the lower thickness of the cathodic film produced by increasing the temperature.

The results of various experiments are given in Table III.

TABLE III.

Concentration of $CrO_3 = 250$ gr. per litre.

C. D.	H_2SO' gr. per l.	ratio	°C.	Appearance
6.5	1.4	178	25	Frosty
6.5	1.4	178	30	Bright
6.5	1.4	178	35	Bright+
9	2.5	100	25	Burnt
9	2.5	100	30	Frosty
9	2.5	100	35	Bright
9	2.5	100	40	Bright+
10	3.5	71	25	Burnt
10	3.1	71	30	Frosty
10	3.5	71	35	Bright
10	3.5	71	40	Bright+

[39] Indeed, with a greater concentration of SO_4 ions a bright chromium plate results.

Conclusions.

The results can be briefly summarised as follows:

The brightness of the chromium deposit depends upon the thickness of the cathodic film and on the quantity of SO_4 ions present at the given temperature. The thickness depends upon the current density and on the temperature, since with a rise of temperature it tends to become thinner.

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BIBLIOCHRESIS: THE PILOT OF RESEARCH.*

By William A. Hamor and Lawrence W. Bass.

Bibliochresis, the scientific use of literature, has the pilotage of all scientific investigation. It has, in fact, the same relation to research as the latter has to management; it is the intelligence service of all orderly inquiry, the preparational agent of factual determination, the guide of experimental trial in eliminating chance, in the whole realm of science.

To be scientific, an investigation of any type must be made methodically—a condition that requires, primarily, that all scientific research be conducted in the light of recorded experience. This requirement applies to the exercise of the historical and analytic procedures of investigation as well as to the employment of the experimental method, whose use, whether for confirmation of for original work, rests upon prior knowledge and art, *i.e.*, accepted practice.

Bibliochresis, then, is the most indispensable tool in laying the foundation for scientific research. Since it enables the qualified worker to find the experience of his predeces sors, as recorded in the literature, it confers upon him either the power to predict the results of effort—this is the outcome if the recorded information is evidently factual, *i.e.*, definite and confirmed—or the ability to plan further research on the same or an analogous topic.

The collection of recorded exerience—the function of bibliochresis—is plainly the provision of data for facilitating scientific decision and for projecting research. The factual information thus acquired is the groundwork for the comparison and measurement that compose analytic research; it is also the foundation for gaining the new ideas that characterize invention and discovery. Continued progress in science became possible only when the development of the art of printing enabled investigators to make use of the recorded observations of other scientists.

The necessity for a literature search as a prelude to experimental investigation, either disinterested or industrial, has long been an axiom of the scientific professions. The importance of this first step has often been stressed, but rather as a policy of pedagogical value than as a defense of the procedure. Laments at the increasing volume of scientific literature have become hackneyed, demands for more efficient abstracts and reviews have become strident, but these various voices have not been raised against the value of an intimate knowledge of previous researches in a given field.

Of the men best qualified to analyze the factors that lead to high scientific attainment—research directors, personnel managers, experienced investigators, technical editors, educationists—few will deny the necessity of library studies as a discipline for the selfconceit of the researchful mind. The scientific societies and organizations and the philanthropic agencies for the advancement of science have been unanimous in recommending increased use of existing facilities and concerted effort to improve the technical libraries throughout the world.

The opinion of these authorities concerning the value of bibliochretic work and opportunities is confirmed by several facts.

(1) Bibliochresis occupies a prominent place in the curricula of research training schools. For example a number of universities are now giving courses in chemical bibliography. Among the text-books dealing with the subject wholly or in part should be mentioned "The Literature of Chemistry," by Crane and Patterson; "Chemical Publications," by Mellon, and "Introduction to Organic Research," by Reid. "Medical bibliography" is another pedagogic innovation.

(2) There is a constantly increasing demand in industrial laboratories for Chemical bibliographers, other scientific literary specialists and chemical economists.

(3) The recognition of the need for bibliographic material in compact form is shown by the demand for indexes to the literature, as evidenced by the large number of orders received by their publishers.

(4) Satisfactory incomes, considering everything, are enjoyed by a number of practicing bibliographers who specialize in preparing, for stipulated fees, select biblio-

* Abstracted from *Science*, 1930, LXXI, 875.

graphies and also reviews of the journal and patent literature.

(5) Many men have been found to be unsatisfactory in industrial research because of their lack of knowledge of elementary bibliochretic procedure. How often in our personnel work we have seen the criticism of a referee of a candidate to the effect that the latter " was not able to work with ease and interest in literature searches " or " was replaced by a better man because he could not be depended on to make a thorough survey of the literature."

(6) Systematic bibliochresis is the means of establishing authority and originality, in science as well as in history and jurisprudence.

There is considerable difference in many cases between the character of the library work appropriate for academic and that for industrial research. In the field of pure science, searching literature studies are made more or less as a matter of course. Such work is for the most part carried out in universities or research institute with good bibliographic facilities and with somewhat more deliberate an atmosphere than that in an industrial laboratory. There is usually a professor or research director to plan the investigation, which is generally for a thesis. The problem selected must be reasonably free from ever-lapping studies in order that the junior author may be assured of a research publication; he is supposed to publish a paper to fulfil all the requirements for his degree, or, at least, he is eager to be able to treasure reprints of an additional to his short list of papers. In either case, the disappointment aroused by finding that his efforts have been dissipated on something already worked out is not to be taken lightly by those who are training our youth for enthusiastic scientific careers. Then, too, his own efforts to make use of the library are not to be overlooked. An exhaustive bibliography is an essential part of his thesis (and it is to be regretted that more theses, with their extended bibliographic studies, are not available for general use). In his conversations with fellow students he incites them to destroy the historical background of his work. Finally, when the completed article is submitted to a journal, a board of editors jealously guard against the duplication of a previous publication. It must be remembered also that the literature pertinent to a problem in pure science is likely to be more easily located than in the case of an industrial project. In spite of all these precautions, unwitting duplication of results is not unknown.

The bibliograhpic problems of the industrial research man are much more complicated. He is expected to use his time to the best advantage. He must work in libraries that, as a rule, are not so thoroughly stocked as those of the universities, although this condition is being improved markedly. The literature of industrial science is more difficult to follow: the journals for both the technical and pure science pulications must be examined; the patent literature must be much more carefully searched than in the case of pure science research; the publications of most interest to him will often contain veiled meanings, and finally, the things for which he is searching may have been done but never published. This last possibility is of the greatest importance in connection with supposedly patentable process and products.

There are, it is true, some scientists in both pure and applied research who have been eminently successful in spite of the fact that they have purposely refrained from systematic use of the existing literature. They are usually of the genius type, men of great originality and resourcefulness, who would have achieved fame in any field.

Few of us can attain to his heights. As time goes on and the various fields become more and more thoroughly worked over, genius will find it increasingly difficult to assert itself.

It seems to us that the attitude of mind of the man who can achieve continuous research success without using the literature systematically is susceptible to further analysis. He has a profound knowledge of his speciality and he keeps in touch with current progress, although in a desultory fashion. His self-confidence is maintained by his achievements as well as by his grasp in the field. He can therefore plan new work by visualization with reasonable accuracy. Self-satisfaction with his procedure comes to him through his success.

An aspect of bibliochresis seldom emphasized is that, in the hands of a specialist endowed with imagination, trends in research can be analyzed and forcasts can be made with a reasonable degree of probability. The worker can avoid fields in which, from a survey of the literature, it appears that too many groups of workers are engaged to give promise of marked success if he starts in, far behind, to catch up with the others. On the other hand, a particularly keen man can sometimes perceive an important goal which the mass of workers have been too preoccupied to see.

Organization is characteristic of the age. *All human activities are becoming more and* more a matter of co-ordinated regulation. The dietetically chosen food we buy on a budget plan from a chain store has been *systematically approved* by city, state and national health officers; it has been distributed, with or without intermedaries, to the retailer according to his calculated sales volume by the manufacturer, who has prepared its reception by scientifically executed advertising; it has been transported over railroads whose interrelations are controlled by governmental regulation based on economic reasoning; the raw materials were selected by means of standardised tests; even the ultimate producers are now being more and more firmly knit together by the economic necessity for management on scientific principles.

The same spirit of organisation hovers over the research laboratory, which creates such products. The haphazard methods of the inventor will experience increasing difficulty in competing with organised research, both in pure and applied science. As the literature increases, more and more critical studies will be required, and still larger research units will be obliged to correlate their efforts to avoid duplication. It is not the time to urge less use of the library, but to encourage research workers to follow the literature as never before.

The Mellon Institute of Industrial Research.

GENERAL NOTES

SEVENTY YEARS AGO.

(From the Chemical News, Dec. 10, 1859.)

ON THE EMPLOYMENT OF CARBON AS A MEANS OF PERMANENT RECORD.

By JOHN SPILLER, F.C.S., *of the War Department.*

The undoubted superiority, in respect to the quality of permanence, of ordinary printed characters in comparison with the several kinds of manuscript, renders it desirable that efforts should be directed to the possibility of availing ourselves of the unalterable nature of carbon, the principal ingredient in printer's ink, with a view to the employment of the same as a substitute for the tannate of iron in the ordinary black writing fluids. The want of permanence constantly attributed to the latter, and borne out by the inspection of manuscript deeds of comparatively recent date, seems inherent to an ink which depends solely for its permanence on a weak chemical affinity exerted between the oxides of iron and the product of a vegetable infusion, which, left to itself is constantly undergoing change. Hence, the application of dilute acids, both mineral and organic, is sufficient either to obliterate or render illegible the characters written with such ink; while its composition makes it liable to fade under circumstances no more unfavourable than that of exposure to a damp or impure atmosphere.

On the other hand, the imperishable nature of carbon, in its various forms of lamp black, ivory black, wood charcoal, and graphite or black lead, holds out much greater promise of being usefully employed in the manufacture of a permanent writing material; since, for this substance, in its elementary condition, and at ordinary temperatures, there exists no solvent nor chemical reagent capable of effecting its alteration. Carbon is destroyed, or rather oxidised, only by fire, and by the long continued action of the strongest acids; only under such circumstances, therefore as the tablet of prepared vegetable or animal substance is itself unable to withstand. Provided, then, that sufficient means can be adopted for securing its perfect adhesion to the surface, or passage even into the pores, or the paper (a point not sufficiently considered, perhaps, in the production of the so-called permanent carbon photographs), there seems every probability of a carbon pigment resisting the effects of time and other corrosive influences better perhaps than any other substance, elementary or compound, which is likely to be brought into comparison with it. The perfect state of preservation of the early engravings and pages of printed type corroborates this view; they exhibit in some instances evidence of destruction by decay of the paper itself, rather than that of the carbonaceous material forming the subject of the picture.

The suggestion relative to the mode of applying carbon to these purposes, which it is intended more particularly now to enunciate, depends on the fact of the separation of carbon from organic compounds, rich in that element, sugar, gum, &c,. by the combined operation of heat and of chemical reagents, such as sulphuric and phosphoric acids, which exert a decomposing action in the same direction; and by such means to effect the deposition of the carbon within the pores of the paper by a process of development to be performed after the fluid writing ink has been to a certain extent absorbed into its substance. A system of

formation by which a considerable amount of resistance, both to chemical and external influences, appears to be secured. An ink of the following composition has been made the subject of experiment :—

Concentrated sulphuric acid, deeply coloured with indigo	1 fluid ounce
Water	6 „ „
Loaf sugar	1 ounce troy
Strong mucilage of gum arabic	2 to 3 fluid ounces

Writing traced with a quill or gold pen dipped in this ink dries to a pale blue colour, but if now a heated iron be passed over its surface, or the page of manuscript held near a fire, the writing will quickly assume a jet black appearance, resulting from the carbonisation of the sugar by the warm acid, and will have become so firmly engrafted into the substance of the paper as to oppose considerable difficulty to its removal or erasure by the knife. On account of the depth to which the written characters usually penetrate, the sheets of paper selected for use should be of the thickest make, and good, white, cartridge paper, or that known as "cream laid," preferred to such as are coloured blue with ultramarine, for in the latter case a bleached halo is frequently perceptible around the outline of the letters, indicating the partial destruction of the colouring matter by the lateral action of the acid.

The writing produced in this manner seems indelible; it resists the action of "salts of lemon," and of oxalic, tartaric, and diluted hydrochloric acids—agents which render nearly illegible the traces of ordinary black writing ink; neither do alkaline solutions exert any appreciable action on the carbon ink. This material possesses, therefore, many advantageous qualities which would recommend its adoption in cases where the question of permanence is of paramount importance; but it must, on the other hand, be allowed that such an ink, in its present form, would but inefficiently fulfil many of the requirements necessary to bring it into common use. The peculiar method of development rendering the application of heat imperative, and that of a temperature somewhat above the boiling point of water, together with the circumstance that it will be found impossible with a thin sheet of paper to write on both sides, must certainly be counted among its prominent disadvantages.

Though not perhaps capable of employment on the animal tissues, vellum and parchment, there is every probability of its successful application in connection with the new material produced by the action of strong acids on paper, and known under the name of vegetable parchment.

Royal Arsenal, Woolwich.
Dec. 5th, 1859.

FIRST COPY OF "THE CHEMICAL NEWS."

No. 1, VOLUME I, DECEMBER 10, 1859.

Among the contents of the above are :—

"On Vapour Volume," by Greville Williams.

"On a New Process for Preparing Certain Chlorinated Derivatives of the Benzole Series," by Arthur H. Church, F.C.S.

"On the Separation of the Oxides of Nickel and Cobalt from Peroxide of Iron," by Frederick Field.

"On Platinum and its Associated Metals," by M. M. Deville and H. Debray.

"On the Employment of Carbon as a Means of Permanent Record," by John Spiller, F.C.S.

"Researches on Colocynth," by M. Walz.

"Magnetic Peroxide of Iron—Detection of Metallic Poisons in Medico-Legal Inquiries."

"Reinsch's Test for Arsenic.—Arsenic in Green Paper Hangings."

"Binoxide of Hydrogen.—New Stopping for Decayed Teeth."

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ROTHAMSTED REPORT FOR 1929.

The Rothamsted Experimental Station, Harpenden, was founded in 1843 for the scientific study of Agriculture by Sir J. B. Lawes who, with Sir J. H. Gilbert conducted a large number of important investigations during a period 60 years. Sir A. D. Hall was the director from 1902 until 1912 when he was succeeded by Sir E. J. Russell. The work has been extended in many directions, as the last few Annual Reports testify and the laboratories have been re-organised and the equipment increased. It is now attracting the interest of overseas authorites who send specialists to be trained in the methods and technique adopted at Rothamsted.

The purpose of the Rothamsted work is to discover the principles underlying the

facts of agriculture and to put that knowledge in a form in which it can be used by teachers, farmers and others for the improvement in the standard of farming. The investigations have been mainly concerned with crop production. They include soil management (a new Imperial Bureau of Soil Science under the directorship of Sir E. J. Russell has recently been formed), the use of fertilisers, the control of plant diseases and of crop valuation. The reason why some methods are good and others not has been sought, so that the agriculturists may be saved as much trouble and expense as possible in methods of crop production. Crop experiments, decomposition of plant resides, accuracy of field experiments, the duration of the effort of following and the question of winter and home-grown food for stock are all considered in this Report.

There is also a summary of a number of scientific and technical papers.

COMMERCIAL TRAVELLERS' LICENCES IN PANAMA.

An agreement has now been concluded between the United Kingdom and Panama, which provided, *inter alia*, that commercial travellers visiting Panama could obtain a licence on payment of a single fee, and that such licence should be valid throughout the whole of Panama. To obtain such licence each applicant is required to procure a certificate attesting his character as a commercial traveller. This certificate should be obtained by the traveller from his local Chamber of Commerce before leaving this country.

On presentation of such certificate, which has to be legalised by a Consular Officer for Panama in this country, the commercial traveller is able to procure a licence at a cost of 25 dollars from the municipal authorities in Panama. If the document is not in the possession of the commercial traveller, considerable difficulty may be experienced in procuring the licence on arrival in Panama.

Proceedings and Notices of Societies

THE PHYSICAL SOCIETY.

DISCUSSION ON MAGNETISM, HELD ON MAY 23.

Ferromagnetism and Hysteresis. By SIR ALFRED EWING, K.C.B., F.R.S.

A review of early work on hysteresis in the ferromagnetics, symbolic models of magnetic structure, and the author suggests that ferromagnetism affords the most promising source of clues to outstanding problems of magnetic theory.

Magnetism in the Twentieth Century. By EDMUND C. STONER, Ph.D., University of Leeds.

The state of magnetism at the beginning of the century was indicated and the work up to 1913, mainly that of Langevin and Weiss, is briefly described. The outlook during the quantum-principle period (1913-25) and after the reformulation of the quantum theory is sketched. Against this background the theoretical and experimental progress made in connection with dia-, para- and ferro-magnetism is considered.

The diamagnetic susceptibility of atoms and ions is in good agreement with the charge distribution indicated by wave mechanics; the susceptibilities of molecules give information as to their sizes, and of crystals as to the sizes and shapes of the molecules in them.

Paramagnetic theory applies particularly to ions of the various transition series of elements. For the rare earths the observed magnetic moments agree with those corresponding to the ground states deduced by Hund's method. For the other series the susceptibilities support the view that the effective electrons (those in incomplete groups), being on the outside of the ions, take part in interaction with neighbouring ions.

Ferromagnetism is considered in the light of the molecular field hypothesis, and the following topics are discussed: spontaneous magnetisation, the nature of the "carriers," specific heat, the Barkhausen effect, single crystals, Heisenberg's theory of the molecular field, ferromagnetic materials.

The importance of the work on strong magnetic fields is indicated, and the magnetic properties of the elements are briefly discussed.

Magnetism and the Quantum Theory. By PROF. H. S. ALLEN, M.A., D.Sc., Professor of Natural Philosophy in the University of St. Andrews.

The results of the modern form of the quantum theory are reviewed in relation to the explanation which they afford of magnetic phenomena. Reference is made to the magnetic moment of the spinning electron which appears to play an important part in the new quantum mechanics, and to the explanation of the molecular field of Weiss as originating in the quantum interaction between electrons. The necessity for taking into account the principle of relativity is emphasised in connection with the possible structure of the electromagnetic field: the quantum theory may demand four-dimen-

"Alkaloids in Aconitum. VII. General Remarks on the Alkaloids in Aconitum." By Riko Majima and Shin-ichi Morio.

"Stereochemical Studies on Hydronaphthalenes. I. Reduction of β-Naphthol at High Temperature under High Pressure." By Sakujiro Kimura.

"Sinomenine. XVI. Isobromosinomenine (or Dehydrobromosinomenine)." By Kakuji Goto and Taro Nambo.

"Carthamin. I." By Miss Chika Kuroda.

"Carthamin. II. β-Carthamidin Methyl Ether and its Synthesis." By Miss Chika Kuroda.

"Reduction of Cineol with Hydrogen in the presence of Copper Catalyst." By Yasuji Fujita.

"Action of Sulphuric Acid on Cineol in Alcoholic Solution." By Yasuji Fujita.

"Dichloro-phenol Derivatives. I." By Munenari Tanaka, Kiyoshi Morikawa, and Shigeru Sakamoto.

"Thermodynamical Study of Chemical Change. VII. Thermodynamical Study of Potassium Hydroxide." By Eiichi Shibata, Saburo Oda and Shizuto Furukawa.

Thermodynamical Study of Chemical Change: VIII and IX. Thermochemical Study of Potassium Sulphate and Sodium Sulphate." By Eiichi Shibata, Saburo Oda and Shizuto Furukawa.

"Chemical Reactions between Metals of Alkali and Alkaline Earth Groups (including Magnesium) and Water, Acids and Caustic Alkalis." By Ityro Iytaka.

NOTICES OF BOOKS.

Metalliferous Mine Surveying. By THOMAS G. HANTON. Pp. 236. 82 illustrations. London: Crosby Lockwood & Son, Stationers' Hall Court, Ludgate Hill. 1930. Price 15s. net.

The want has long been apparent of a work presenting in a composite form the most important features of modern mine surveying practice, which at the same time considers from a practical viewpoint the various problems affecting the mine surveyor.

This has been attempted in this new work.

The author is a graduate in mining of the University of Sydney, N.S.W., and has had several year's experience of mine surveying under various conditions, so his writing may be accepted as authoritative.

The Measurement of Hydrogen Ion Concentration. By JULIUS GRANT, M.Sc., Ph.D., A.I.C. Pp. viii + 159. London: Longmans, Green & Co., 39, Paternoster Row, E.C. 1930. Price 9s.

The conception of hydrogen ion concentration as a more exact expression of acidity has only received attention and application during the last 10 years, during which period it has found important uses in attacking problems in such widely separated fields as Agriculture, Fermentation industries, Leather manufacture, Paper industries Pharmacy, Metallurgy, and Water Analysis.

The present volume on the subject is particularly welcome in view of the increasing importance of a knowledge of the measurement of hydrogen ion concentration. A study of it is essential to students and scientific workers in numerous branches of science and industry. Part I is theoretical and introductory, whilst Parts II (Electrometric) and III (Colorimetric) are devoted to the practical technique of the measurements. Part IV describes the practical applications of the methods in particular and typical cases and finally some useful recent and reliable data are tabulated in Part V for ready reference.

Paint, Powder and Patches: A Handbook of Make-up for Stage and Carnival. By H. STANLEY REDGROVE, B.Sc., A.I.C., AND GILBERT A. FOAN. Pp. xii + 170 + 16 plates. London: William Heinemann (Medical Books) Ltd., 99, Great Russell Street, W.C.1.

The preparation of grease-paints and other cosmetics required for stage purposes constitutes a branch of applied chemistry concerning which information is extremely difficult to obtain. For long, a work dealing with the subject in a scientific and comprehensive manner has been badly needed. We are surprised, indeed, that it has not been written before; but are gratified, now that the task has been essayed, that it has been accomplished in so excellent a manner, in the book before us, by the authors of the standard work on hair-dyes *Blonde or Brunette?*

The book is divided into two parts, of which the second deals with the practical side of making-up. This gives a lucid account of all the mysteries of the art, which will be found useful, no doubt, both by professional actors and the very numerous body of amateurs.

The first part, which is more particularly the concern of the chemist, treats of the composition and preparation of the various cosmetics required. Two of these chapters deal with raw materials. One of these is concerned with oils, fats and waxes; whilst the other, which is the longest chapter in the book, surveys in considerable detail the colouring matters which are or may be em-

ployed. Two points are constantly kept in view in this chapter: the actual colour values of the various pigments and dyes, and the possibility of their exercising any toxic action on the skin.

Three chapters are devoted to the preparation of the various cosmetics, numerous formulæ being given which should be of great assistance to manufacturing chemists. in particular, the book contains a complete formulary for the preparation of grease-paints in all necessary colours. For the most part, the formulas differ considerably from those few which have hitherto been published elsewhere, the authors' aim having been to devise methods of obtaining the necessary tints without using materials, such as vermillion, chromes, etc., etc., which might exercise a toxic action. One novelty is the employment of titanium dioxide.

The book is profusely illustrated, is indexed and is provided with a bibliography. It is a thoroughly sound and scientific treatise of real practical value.

INDIAN MEDICAL SCIENCE.

The Indian Medical Record.

Established in 1880 the *Indian Medical Record* attained this year its jubilee and the event is marked by the publication of a special issue of 140 + lxiv pages, illustrated with many plates and surveying the history and the corporate progress of Medical Sciences, especially in India.

The journal itself was founded by the late Dr. J. R. Wallace, but it had at first a chequered career up to 1890. From 1892 to 1900 it was issued fortnightly and from 1900 for some time it appeared weekly. Dr. Wallace died in 1908. Dr. E. S. Pushong, Dr. A. C. Bisharad, and Capt. P. Ganguly all became editors before the present illustrious Dr. S. K. Mukherji, who entered upon these duties in 1921 and who has done much educative work for Indian Medical Science. He has instigated and assisted in the campaigns against Tuberculosis, Kala-azar, leprosy and venereal diseases, and has stimulated an interest in indigenous drugs.

Interesting biographical notes on others, including Mr. A. K. Ghatak and Mr. H. N. Chatterjee, are also given in the Jubilee issue.

Among the more significant contributions to this number, mention may be made of the following:—

"The Advance of Western Medicine and Surgery in India." By Dr. N. N. De.

"India's Contribution to the Solution of the Kala-Azar Problem." By Dr. L. E. Napier.

"The Trend of Modern Medicine: Disease and its Treatment." By Dr. A. Roy.

"Recent Advances in the Treatment of Leprosy." By Dr. E. Muir.

"The Rôle of Radium in Gynæcological Surgery." By Dr. S. Mitra.

"Hazards of Radiology and Precautions for Prevention." By Dr. K. M. Hiranandani.

"Indian Dietary and Health." By Dr. B. C. Bhatacharjee.

"Vedic Medicine." By Dr. G. N. Mukherjee.

The medicines in use and their manufacture. There are also short notes on proprietaries and special preparations and an account (illustrated) is given of the Bengal Immunity Laboratories.

Much remains to be done in regard to the raising of the general standard of health in many parts of India and the *Indian Medical Record* has an important mission in that respect. The present administration and control evidently take their duties seriously and we hope they will receive the adequate support they deserve. Other themes are apt to overshadow the attention which should be bestowed upon the advancement of science and medicine in India but these, it should be remembered, are essential to any form of progress.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

17,815.—I. G. Farbenindustrie Akt.-Ges.—Chlorination of diphenyl. June 10.

18,108.—I. G. Farbenindustrie Akt.-Ges. Manufacture of leuco sulphuric acid esters, etc. June 12.

18,271:—I. G. Farbenindustrie Akt.-Ges.—Production of anthraquinone derivatives. June 14.

18,180.—I. G. Farbenindustrie Akt.-Ges.—Manufacture of acylamino-benzene stibinic-acids. June 13.

Specifications Published.

380,218.—Smith, W., Thomas, J., and Scottish Dyes, Ltd.—Production of anthraquinone derivatives.

316,858.—Schmidt, Dr. F.—Hardening of condensation products from phenols and aldehydes.

330,226.—Tocco, L.—Process for activating chemical reactions.

330,228.—I. G. Farbenindustrie Akt.-Ges. —Manufacture and production of phosphoric acid esters.

307,304.—I. G. Farbenindustrie Akt.-Ges. —Process for the manufacture of amino alcohols.

Abstract Published.

328,418.—Amines.—Imperial Chemical Industries, Ltd., Millbank, London, and Allchin, L. J., Crumpsall Vale Chemical Works, Blackley, Manchester.

Vic-m-aylidine is obtained from the mixture of isomeric xylidines remaining, after the removal of the bulk of the *p*- and *asym-m*-xylidines by the usual processes from the reduction product of crude nitroxylenes, by dissolving in moderately concentrated hydrochloric acid and adding to the hot solution the chloride of a metal of group II(b) of the Periodic System, *e.g.*, zinc chloride, cooling, and filtering the crystalline precipitate. In an example, the crude oil obtained as described above, is dissolved in hydrochloric acid, heated, and powdered zinc chloride is added solid or in solution. The crystalline precipitate obtained on standing is filtered, washed, and basified with sufficient or slight excess of alkali, and the *m*-2-xylidine distilled in steam.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

ALTEX.

512,941.—Chemical substances used in manufactures, photography, or philosophical research, and anti-corrosives.—British Dyestuffs Corporation, Ltd., Hexagon House, Blackley, Manchester. June 18.

B511,031.—Illustration of a triangle bearing the letter S, and the word Sandox. Chemical substances for use in manufactures, and anti-corrosives. Chemical Works formerly Sandoz, also trading as Chemische Fabrik Vormals Sandoz, and as Fabrique de Produits Chimiques Ci-Devant Sandoz, 60, Fabrikstrasse, Basle, Switzerland. June 18th.

GENERAL INDEX TO THE "CHEMICAL NEWS"—VOLS. 1 TO 100.

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NOTICE TO AUTHORS & CORRESPONDENTS

Contributions for publication either as original articles or in the correspondence columns are welcomed by the Editor of *The Chemical News.*

They must be accompanied by the contributors' full names and addresses, not necessarily for publication, but as an indication of good faith. If a reply is needed or if it is desired that a manuscript which is not accepted for publication be returned, a stamped addressed envelope should be enclosed.

No notice can be taken of anonymous letters.

AIR TRANSPORTATION FOR GOLD BULLION.

The importance of the aeroplane in connection with the development of new mining areas in Canada is again illustrated by the despatch recently from the Howey gold mine in northwestern Ontario, of $75,000 worth of bullion. The use of the aeroplane in this initial consignment of gold from the mine is particularly fitting in view of the fact that aerial navigation has played such an important role in bringing this remote property into production. The Howey gold mine is situated in the Red Lake area in the Patrica district of Ontario and is located 110 miles north of the aerodrome at Sioux Lookout, where connection is made with the Canadian National Railways. Development of the mine has been in progress since 1925, and the new gold field itself is the first of the newer gold mining areas opened up in Ontario during the past ten years.

Transportation, always an important factor in the development of a new mine, has proved to be a costly item for Howey Gold Mines, Ltd., averaging from about $110 per ton in winter to half that amount in summer, when a continuous water route was available with the aid of "marine railways" to assist in carrying supplies and equipment across the portages. The opening up of this mine also demonstrates the importance of hydro-electric power in conjunction with mining development in most parts of Canada Far away from existing sources of electric power, it is found necessary early in 1929 for the Company to enter into an agreement with the Ontario Hydro-Electric Power Commission for the supply of 2,000 h.p. at $25 per h.p. year, transmitted over a power line 40½ miles in length from the new generating station installed by the Commission at Ear Falls on the English River. The cost of the development to the mining company was approximately $275,000, and the power will be sufficient to operate a mill of 2,000 tons daily capacity. A 500-ton daily capacity cyanide mill with a coarse crushing capacity of 1,000 tons per day began production in March and is now treating approximately 400 tons of ore daily assaying about $7 per ton. The tailings are stated to assay as little as 20 cents per ton and the operating costs are believed to be under $5 per ton on the present basis of working. On the basis of the present rate of production, indications are that weekly consignments of bullion will be about $20,000.

INDIUM: RECOVERY BY ELECTRODEPOSITION.

By L. R. Westbrook.

(*American Electrochemical Society, Fifty-seventh General Meeting, held at St. Louis, May, 1930.*)

Indium was discovered spectroscopically in 1863 by Reich and Richter in Freiburg zinc blende, and named from the prominent indigo-blue lines which characterise its spectrum. It is one of the comparatively rare elements which has not yet been found as the predominant constituent of any mineral, but occurs rather widely distributed in minute amounts in the majority of zinc blendes, in some tin ores, pyrites, siderites and tungsten ores.

The Freiburg blende was reported to contain 0.1 per cent. In; the other sources usually are shown to contain much less; from a few hundredths of 1 per cent. to spectroscopic traces. Hofman lists indium as present in spectrographically detected amounts in 28 out of 49 commercial zinc spelters.

Properties.

Indium is a white, lustrous metal, very soft and ductile, slightly heavier than zinc, melts at 155° C., and boils at about 1450° C. It does not tornish appreciably in air at ordinary temperatures, but oxidises rapidly above its melting point, burning with a brilliant flame at higher temperatures.

Chemically, indium resembles zinc in some respects, and aluminium and iron in others, being classified with the latter elements in the usual systems of qualitative separations. It is trivalent in its stable compounds, and its sulphate forms alums with monovalent metal sulphates.

Most indium salts are colourless and very soluble in water; hence do not crystallise easily. The white hydroxide is precipitated by the alkalies, and is soluble in an excess of sodium or potassium hydroxide at room temperature, but is re-precipitated on boiling or high dilution; it is insoluble in an excess of ammonia, and is completely precipitated by that reagent on boiling.

The trioxide, brown when hot and light yellow at ordinary temperatures, is easily prepared from the hydroxide by calcination at low red heat. The sulphide is usually bright yellow, and it best precipitated from acetic acid solutions by hydrogen sulphide. Ordinarily the sulphide is not precipitated with Group II metals by hydrogen sulphide in the presence of mineral acids, but, like zinc, it may partially precipitate from concentrated solutions; also it may contaminate other Group II sulphides, when co-existent with those metals in solutions of low mineral acid concentration.

Literature on Electrodeposition.

Metallic indium can be obtained from the oxide by reduction with carbon or hydrogen at elevated temperatures, from the chloride by fusion with metallic sodium, and from its electrolytes by displacement with metallic zinc or better by electrodeposition. The literature on this subject is concerned principally with methods for the quantitative determination of the metal, and its purification in small amounts, and deals with electrodeposition from solutions of low indium concentration.

Thiele deposited indium from solutions slightly acidified with sulphuric acid, on silver-plated platinum cathodes, because he claimed indium alloyed with platinum when deposited directly thereon. Dennis and Geer avoided this action by replacing the free sulphuric acid with formic acid. They also found that pyridine and hydroxylamine were valuable addition agents for electrolytes acidified with mineral acids, and observed that deposition from oxalate solutions was unsatisfactory and incomplete, while deposits from acetate baths were dark and spongy. They recommend a formic acid bath containing from 1 to 7.5 grams of indium, 5 grams of ammonium formate and about 130 grams of free formic acid per litre, electrolysed at a cathode current density of 9 to 12 amp. per sq. dm.

Kollock and Smith used solutions containing 20 grams of indium per litre as sulphate, in experimental portions of 10 to 20 ml., and found that the metal could be quantitatively deposited in about 40 minutes at cathods current densities of 3 to 6 amp. per sq. dm. at 60° C., preferably in the presence of a little gelatine and either free sulphuric acid or acetic acid and sodium acetate. Their best deposits were otbained from an indium sulphate solution of the above concentration, containing 75 to 150 grams of Rochelle salts per litre. They also recommend the use of a mercury cathode with rotating anode for quantitative determinations.

F. C. Mathers employed fractional electrolysis of a slightly acid indium sulphate solution, as a step in the purification of the element for the determination of its atomic weight.

Experimental.

In the purification of crude zinc liquors obtained by acid leaching zinc cinder, or roasted blende, indium, when present, is removed along with cadmium, lead and the other elements replaceable by treatment with metallic zinc. Indium then follows cadmium through the processing of the crude sponge as obtained, and is later removed from the cadmium liquors along with iron and a number of other impurities present in small amounts.

The recovery of indium from these residues containing usually a few tenths of one per cent. of the element, probably as hydroxide, involved separation from a large amount of iron and smaller amounts of cadmium, magnesium and silica. The most of the iron, aluminium, lead, titanium, calcium, magnesium and silica were eliminated by precipitation of sponge indium from filtered sulphate solutions, on zinc shavings of high purity.

The resulting sponge was rich in indium, and contained, besides zinc, small amounts of iron, aluminium, titanium and silicon, probably as basic compounds, along with cadmium, copper, nickel, tin, lead, and antimony, these elements being co-precipitated with indium by zinc. Filtration of a solution of the sponge in hot dilute nitric acid eliminated most of the tin and antimony, and precipitation of indium hydroxide from the filtrate separated it after washing from most of the cadmium, zinc, copper and nickel.

Treatment of a solution of the washed hydroxide in hydrochloric acid of proper acidity (about 0.3 *N* HCl) with hydrogen sulphide effected final separation of the remaining copper, cadmium, lead antimony and tin. The small amounts of zinc and nickel still left were removed by precipitating indium hydroxide from the H_2S-free filtrate with ammonia, and washing by decantation.

These processes were repeated until the elements to be eliminated were completely removed. The indium hydroxide press cake, obtained on final filtration, was dried and converted to oxide by calcination at 600 to 700° C. Spectroscopic examination showed that the resulting product was of high purity (about 99.5 per cent.), and contained only traces of the oxides of iron, aluminium, titanium and silicon, which were finally eliminated in the process of electrolysis for the deposition of metallic indium with a purity of about 99 per cent.

Electrodeposition.

For the recovery of metallic indium from several pounds of this purified oxide, electrolytic baths of considerably higher concentration than any described in the literature were desired. A number of representative types of baths were tried under different conditions of electrolysis over periods of 24 to 48 hours, or longer if necessary, in order to establish the physical characteristics of the deposit produced. These experiments were conducted with about half a litre of bath, usually 1 to 4 *N* in indium. The anodes were platinum, and the cathodes were thin sheets of smooth cold rolled steel, 4.5 × 11 cm.

Indium deposits satisfactorily from freshly prepared double cyanide solutions, but, unfortunately, such baths are subject to deterioration. Addition of sodium cyanide to a solution of an indium salt produces a precipitate which is soluble in an excess of that reagent, forming a clear solution stable for a time, depending on concentration, temperature and excess of cyanide. Invariably, however, decomposition takes place with separation of insoluble indium compounds, and formation of gradually darkening products of cyanide decomposition.

Filtration after the reaction is complete yields a clear dull brown liquor and a chocolate-coloured residue containing all the indium. No means have been found for avoiding this reaction entirely. It is favoured by increase in temperature, concentration, and excess sodium cyanide, and *proceeds only slowly in solutions containing* free hydrocyanic acid in excess instead of sodium cyanide. Solutions of indium hydroxide in excess hydrocyanic acid offered promise, but were not extensively investigated.

Simple chloride and sulphate solutions, about 2 *N* in indium, made by dissolving 98 grams of In_2O_3 in the theoretical amount of acid and diluting to one litre, were next tried. Deposits from these baths were usually satisfactory at first, but as the acidity increased due to the removal of the indium, the hydrogen evolution became marked, and the rate of metal deposition decreased rapidly.

This effect could be combatted by periodic additions of alkali or indium hydroxide, but in trying by this method to build up a thick deposit, it was found to assume a honeycomb structure, due probably to the tendency of the evolved hydrogen to stick to the surface in relatively large bubbles. This could be somewhat reduced by imparting motion to the cathode, and using organic addition agents in the bath, the best being

pyridine, but the results still were not satisfactory.

Following the obvious leads in the literature for reducing the hydrogen ion concentration of the electrolyte, the sodium salts of acetic, oxalic, tartaric, formic and citric acids were added singly to portions of 2 *N* indium sulphate solution, in the proportion of 100 grms per litre, and the resulting baths electrolysed as before.

Deposits from the bath containing sodium acetate, or free acetic acid, were decidedly spongy, as were those from the oxalate bath. The tartrate and formate baths gave compact adherent deposits, but the honeycomb structure, before mentioned, was prominent. The deposit from the citrate bath was markedly superior to the others in physical characteristics; hence this bath was adopted for the recovery work.

Several organic addition agents, including pyridine, nicotine, gelatin, sulphite cellulose waste, the nekals, and a few substituted naphthalene sulphonic acids, were tried in each of the above baths. In every case the effect of the addition agent was detrimental, in decreasing markedly the rate of metal deposition with corresponding increase in hydrogen evolution. Pyridine and nicotine showed a compensating advantageous effect on the physical characteristics of the deposit, and, therefore, might be valuable in indium plating, but for recovery work the lowered efficiency made them undesirable.

The bath composition finally found most satisfactory for electrolytic metal recovery was made by dissolving 200 grams of In_2O_3 in about 600 ml. of water containing 120 ml. of 96 per cent. H_2SO_4, adding 250 grams of $Na_3C_6H_5O_7$. $11H_2O$ (sodium citrate) and diluting to one litre. This bath was electrolysed at room temperature with a cathode current density of 2 amp./sq. dm. using platinum anodes and indium or sheet steel cathodes.

This bath could be stripped completely and discarded, or the indium content could be renewed as depleted by dissolving indium hydroxide press cake in the bath. Dry indium hydroxide was only slowly soluble, and ignited indium oxide very difficultly soluble on boiling only, in exhausted or depleted baths; therefore, not so suitable as the wet press cake, which dissolved easily.

The deposit of indium from this bath was compact, and could be built up to an inch or so in thickness by transfer to fresh or renewed bath as portions were depleted in metal content. These deposits of indium were stripped from the sheet steel cathodes by suspending them over a porcelain dish in an oven at 160° C.

The molten metal casts easily into ingots, and glazed porcelain moulds are quite satisfactory, but the surfaces should have a thin film of vaseline applied to prevent sticking. Over one pound of metallic indium has been recovered so far, from process residues representing many carloads of original ores or crudes, and by the methods outlined in this paper, using the above electrolytic bath for the final step.

Indium is still a laboratory curiosity, as there is no use known for it that will pay for its recovery, although a British patent covers its use in bearing metal. It is quoted for experimental purposes at $6.00 to $22.00 per gram, depending on the purity and amount purchased. This is from about three to eleven times the present price of platinum. The amount of indium known to exist and to be available is decidedly limited. To make the systematic conservation and recovery of indium commercially feasible, it would seem to be necessary to find a use dependent on some unique property that will warrant a price at least comparable with that of platinum.

Like many other rare metals, which only a few years ago were mere laboratory or scientific curiosities, and which to-day have a definite field of usefulness, indium undoubtedly has a definite field of application and the fact that the material is available should stimulate interest in its possible practical applications.

CANADA'S RAPID ADVANCE IN GOLD PRODUCTION.

Estimates published in the "Northen Miner" (Toronto) of May 29th suggest that the gold production of Canada in 1930 will show an increase of as much as 50 per cent as compared with the figures for 1929.

The total production last year, it may be recalled, was 1,927,295 fine ounces worth $39,840,722. Current output, according to the "Northern Miner" is at the rate of $40,200,000 annually in spite of the fact that one of the largest mines in the Porcupine district (Dome) is unable to produce metal owing to the destruction of its mill last year. Within twelve months the gold output may be expected to advance so that the annual production will be at the rate of $61,000,000. There is every reason to believe that Canada will now take the place of the United States as the world's second largest producer of gold. Gold production in Canada reached approximately $36,200,000 in 1926, $38,100,000 in 1927, $39,000,000 in 1928 and $39,800,000 in 1929.

SEVENTY YEARS AGO.

(From the Chemical News, Dec. 17, 1859.)

WHY DO SHIPS ROT?

This question is a very important one to a nation whose Government has paid more than half a million a year for the repairs of ships of war, not to speak of the enormous sums which must have spent in maintaining its mercantile navy in good condition. Up to the present time chemists have busied themeselves more in explaining the nature of the chemical changes which take place in the wood, and in devising means for preventing the disease, than in seeking for the efficient cause of the disorder. Our readers are familiar enough with the processes of Kyan, Burnett, and others, all of which are to a certain extent successful in preserving wood; but in spite of all, the "timber plague" still continues its ravages, and a ship laid up in ordinary, when it is wanted for set, is sometimes discovered to be in a condition which is quite extraordinary. What this "plague" is, chemists explain to us very clearly. They say it is a process of slow combustion, in which the elements of the wood under the influence of air and moisture become converted into carbonic acid and water; and they give the process the fine-sounding name of Eremacausis. But what brings about this change? No doubt there are many causes; but a paper which we publish to-day reveals one which is perhaps the most important of all. It seems that when we build our ships we, with much effort and great noise, drive into the timber agents which are more destructive than the dreaded Black Sea worms. Hitherto it has been done in perfect innocence; but for the future we shall know that, in the opinion of an eminent chemist, and an experienced dockyard officer, one cause of the rapid destruction of the hulls of ships is Iron Nails!

How these act in promoting this destruction our readers will learn when they peruse M. Kuhlmann's paper which has besides a practical bearing on other important matters. M. Kuhlmann believes that the energetic action of sesquioxide of iron is one cause of the spontaneous combustion which to frequently takes place in the waste of cotton and wool, and he thinks that the place where the iron (small fragments derived from the machinery) is deposited is the probable point of departure of the fire.

But M. Kuhlmann's paper also suggests that the destructive action of the sesquioxide may be employed for a very useful purpose. He found that the hydrated oxide agitated with water coloured by various organic matters energetically decolorised it; a fact which leads us to suppose that it might be a valuable agent in the purification of waters for the supply of towns. To this part of the subject we intend to return on an early occasion.

ON THE LOWERING OF CRITICAL POINTS IN MOLYBDENUM STEELS.*

By Takejiro Murakami and Takeshi Takei.

Abstract.

The fact that the critical points in certain molybdenum steels are lowered in steps as the maximum temperature exceeds a certain point, is already well known. In the present work, the conditions affecting the lowering were thoroughly studied, by utilising the magnetic analysis and the dilatometric method for molybdenum steels containing 0·70 per cent. Mo and 0·6 per cent. C and demonstrated that the lowering depends also on the rate of cooling and the composition of alloys, besides the maximum heating temperature.

The effect of the rate of cooling on the lowering of critical points is similar to that of the maximum heating temperature; that is, the critical point is lowered in steps, as the rate of cooling increases; the lowering is, however, markedly affected on the rate of cooling through the normal critical point, though the effect of the rate above the point is practically nil.

The composition range of alloys in which the lowering takes place differs with the cooling conditions. The range was shown in diagrams for respective conditions; in alloys near the eutectoid composition, the lowering readily takes place.

The microstructure of alloys cooled under various conditions was also studied and demonstrated that in alloys in which the lowering takes place, acicular ferrite is always observable and that the higher the maximum temperature and the slower the rate of cooling is, the coarser the structure.

From the result, the cause of the stepped lowering of critical points and formation of the acicular ferrite were satisfactorily explained, assuming the rate of crystallisation curves for respective constituents, *i.e.*, ferrite, carbide and martensite.

* The 241st report from the Research Institute for Iron, Steel and Other Metals. This paper was read at the World Engineering Congress, held November, 1929, in Tokyo.

DERBY ELECTRICITY STATION EXTENSIONS.

Latest Scientific Principles in Pulverised Fuel Firing.

By A Well-Known Engineer.

The recent official opening of the 1929-1930 extensions of the Derby Electricity Station is of the greatest interest because the most recent advances in pulverised fuel firing are represented. The new plant consists essentially of two "*Combustion Steam Generators*," each of 60,000-80,000 lbs. evaporation per hour, and a "Parsons" 20,000 K.W. turbo-generator with turbines of the single cylinder pure-reaction type for high efficiency. The steam generators are fired with "Lopulco" pulverised fuel equipment, which include the entirely new "Volcano" burner and the latest "Duplex" type of pulverised coal feeder, while also the chimney gases are all washed with pressure water sprays to remove fine dust. Pulverised fuel firing according to the "Lopulco" system was first adopted at Derby in 1924 on two "B and W" boilers, while a third "B and W" boiler was installed in 1928, the results being excellent, but the present 1929-30 extensions constitute a further notable advance. The new boilers have been designed and constructed by Combustion Steam Generators, Ltd., of London, a subsidiary of International Combustion Ltd., and consist of a steam and water drum with four complete combustion chamber walls of "Murray" fin water-cooled steel tubes in series with the boiler. Also the roof of the combustion chamber is formed of horizontal boiler tubes with the water screen below the "M.L.S." superheaters, "Usco" multiple plate air heaters and "Foster" steel tube economisers with cast iron fins are included, the pressure being 350 lbs. and the temperature 750° F. The new "Volcano" burner, of which one only is required per boiler, burning up to 5 tons per hour, is a somewhat modified "R" turbulent burner, but fixed in the bottom of the combustion chamber pointing vertically upwards, projecting through the water screen tubes, some of which are diverted for the purpose, the flames therefore spouting upwards. Also the outer casing of the volcano burner is a large firebrick cone, and as with the "R" burner there is both primary air carrying the pulverised coal and secondary air passed to the burner, each of which is given a turbulent motion by helical vanes. Further to increase the mixing action in the combustion chamber, part of the secondary air is now projected from the lower part of the steel tube walls as a series of jets, while no brickwork is used for the boiler setting, which is entirely of steel plate. Also an additional 6-ton per hour "Raymond" pulveriser has been installed, and at the present time Derby has 5 boilers of 60,000-80,000 lbs. per hour evaporation, 2 vertical rabble arm coal driers of the "Rosencrantz" design, and three "Raymond" mills of 6 tons per hour. For feeding the pulverised coal to the burner, two "Duplex" feeders are used, consisting of two horizontal perforated plates with a rotary scraper between, replacing the screw feeders. The washing of all the combustion gases with water sprays to remove grit takes place near the base of the chimney, and Derby therefore, burning also cheap low-grade coal, is another striking example of the fact that a smaller station may be equipped on the most scientific lines and give results equal to the most gigantic superpower station.

ASLIB PANEL OF EXPERT TRANSLATORS.

The attention of the Association of Special Libraries and Information Bureaux has been drawn to the difficulty often experienced in finding translators for pieces of work which require both the necessary linguistic qualifications and a knowledge of the special subject concerned. Accordingly they appointed a Committee consisting of Dr. S. C. Bradford Librarian, the Science Library; Allan Gomme, Librarian, The Patent Office; Dr. R. S. Hutton, Director, British Non-Ferrous Metals Research Association; Miss A. L. Lawrence, M.B.E., M.A., LL.B., Intelligence Officer, British Medical Association; Brig.-General Magnus Mowat, C.B.E., M.Inst.C.E., M.I.Mech.E., Secretary, Institution of Mechanical Engineers; E. I. Robson, M.A., Librarian, Institute of Agricultural Engineering; to consider this problem and to report upon it. The Committee proposed a scheme whereby the Association should act as intermediary between translators possessing the double qualifications of proficiency in one or more languages and expert knowledge of one or more subjects.

A translator who wishes to be registered on the Panel is required to answer a questionnaire (which can be obtained by application to the Secretary of the Association), which is framed so as to provide the Association, in addition to necessary particulars, with full information regarding the applicant's qualifications, linguistic and technical Applications are considered by a Board,

whose decision is final. In certain cases the Board may require the applicant to submit to a test. As a rule only individuals are eligible for registration, but commercial translating bureaux may apply for registration in respect of full-time exployees, or by satisfying the Board of their ability to undertake high-class specialised work.

Languages.

An applicant may apply to be registered for any foreign language, and for any number of foreign languages, but a high standard will be required by the Board. A "fair" knowledge of a language will not be accepted except in special circumstances; for example, where, without possessing a general knowledge of a language, an applicant has special knowledge of some technical terminology in it.

Subjects.

An applicant may apply to be registered for any subject and for any number of subjects, provided that these are sufficiently specialised. What is meant by "sufficiently specialised" cannot be closely defined. Broadly speaking, the "commoner" the language the higher will be the degree of specialisation required. An applicant fully qualified in a "rare" language, such as Chinese, Hungarian, or Turkish, might be accepted with little or no specialised knowledge of any subject. Applicants must use their judgement in this matter and give as much information as possible. If in doubt they may, before completing the questionnaire, send in an enquiry as to whether their subject is likely to be acceptable to the Board. All branches of knowledge—science, law, the arts, etc.—come within the scope of the scheme.

Interpreters.

Included in the Panel are those who are prepared to act as interpreters. The need for this kind of assistance arises frequently when interviews take place between English people and foreign visitors. Often they know no language in common or their knowledge is not good enough to enable them to discuss technical matters.

Registration Fees.

Applications are required to pay a fee of one guinea when they send in their applications. In the case of accepted applications, it includes the first year's registration fee. Thereafter each year when (in order to keep the Panel up to date) registered translators are asked to confirm the particulars regarding their address, etc., they will be required to pay a registration fee of five shillings.

The Association does not guarantee work to registered translators, but intends to advertise the Panel so far as funds received from applicants permit, but accepts no obligation as to the success of the scheme. The fees suggested for registration have purposely been made as moderate as possible; experience will show whether they may need increasing to afford adequate publicity.

The Panel is a private register belonging to the Association, and it will not be published.

To members of the Association the service is available without charge. To others a charge of two guineas is made in respect of each name and address given. Once the Association has served the purpose of effecting the introduction, which may establish a permanent connection of great value to both parties, its interest in the matter ends.

In applying to the Association for the name and address and other particulars of a translator suitable for any piece of work as much information as possible about the work should be given. Whilst the Association takes extreme care to ensure that only fully-qualified and expert persons are admitted to the Panel, it cannot undertake any responsibility in the matter.

26 Bedford Square, W.C.

FIELD RESEARCH IN GEOLOGY AND GEOPHYSICAL METHODS.

Investigations were started in 1928 and continued in 1929 by the Geological Survey Branch of the Canadian Department of Mine with a view to determining the merits of certain methods of geopbysical prospecting for which the owners make very strong claims and which had been employed to a considerable extent in Canada in the search for ore bodies. Three field parties will be sent out during the summer of 1930, to continue these investigations.

Dr. A. S. Eve and Dr. D. A. Keys of Mc Gill University will, in collaboration with the United States Bureau of Mines, conclude investigations started last year into the behaviour of high frequency radio waves underground. Some time will be spent at the Mammoth cave in the State of Kentucky, after which operations will be transferred to the Sudbury nickel-copper district of Ontario. The Mammoth cave has been selected as offering almost ideal conditions—a large underground cavern free from metallic conductors and a rock roof of great thickness. At Sudbury experiments will be made in connection with the Falconbridge and other ore bodies.

Dr. L Gilchrist of the University of Toronto will continue research in the field with a variety of electrical and magnetic methods for the purpose of ascertaining their serviceableness in the search for concealed mineral deposits. The methods will be tried at first on known ore bodies of fairly simple composition such as chromite of Thetford, Quebec, magnetite of Bristol, Quebec, and pyrite of Calabogie, Ontario.

The Dominion Observatory and the Geological Survey are collaborating in research in gravitational methods of studying underground conditions, and Mr. A. H. Miller of the Dominion Observatory started work late last year with the torsion balance to ascertain its use in determining faults. This work was initiated on a known fault in the vincinity of Ottawa and will be continued this year, and experiments will also be made with the torsion balance in connection with known mineral bodies at Calabogie, Ontario, and at Bristol, Quebec, referred to above. The result of these various investigations will be printed and given to the public as soon as possible.

CANADIAN ASTRONOMER RECEIVES ROYAL ASTRONOMICAL SOCIETY'S GOLD MEDAL.

At the annual meeting of the Royal Astronomical Society of England, in London on May 9, Dr. J. S. Plaskett, Director of the Dominion Astrophysical Observatory, Victoria, B.C., was presented with the society's highest and most-prized distinction, the Gold Medal. The award according to the announcement was made for " valuable researches in stellar radial velocities and important conclusions derived therefrom." Dr. Plaskett, by invitation, also delivered on this occasion the George Darwin lecture, one of the most notable opportunities for discussing recent advances in astrnomy.

A month previously, in Boston, on April 8, Dr. Plaskett was presented with the Rumford medal of the American Academy for his researches in the spectra of the stars.

These awards are striking evidence of the high standing of Canada in astronomical research and of her progressiveness in establishing and maintaining two national observatories of the first rank—the Dominion Observatory at Ottawa, Mr. R. Meldrum Stewart, Director; and the Dominion Astrophysical Observatory at Victoria, B.C., under the direction of Dr. Plaskett.

GENERAL NOTES

LITHUANIA MARKET CONDITIONS.

The situation prevailing since Lithuania's creation as an independent State, whereby politics an economics in the young Republic are so closely interwoven, remained unchanged during the year under review, writes H.M. Consul at Kovno in a Report on economic conditions in that country. The unfortunate state of affairs, whereby the frontier with one of her neighbours remained closed, continued to react somewhat detrimentally on the economic progress of the country. Thus her geographical situation, one of Lithuania's unexploited economic assets, remained a source of undeveloped income. By this anomalous situation the transit trade of the great waterway, the river Niemen, remains stagnant, and services, which under normal circumstances could be performed by Lithuania, are transferred to Poland.

Towards the end of the year the Lithuanian Government decided, however, to build the Telsiai-Kretinga railway, which, on completion, will place the well- equipped port of Klaipeda (Memel) in direct line of communication with Kaunas (Kovno), Lithuania's capital; hitherto Klaipeda has been connecected with the capital by a line that runs through Latvian territory.

A study of the present financial condition reveals an improvement of State finances, especially during the past three years, which finds expression in a very satisfactory budgetary position Nevertheless, in examining the general economic conditions prevailing in the country it cannot be said that the satisfactory condition of State finances is in perfect harmony with them, more particularly in agriculture and trade. The agricultural industry, although showing signs of slow progress is, generally speaking, still in a somewhat primitive state of development. The lack of drainage and the resultant, almost exclusive, dependensce of the harvest upon climatic changes, as well as the absence of good roads, continue to react unfavourably upon the general economic situation of the country. It must be mentioned, however, that the Lithuanian Government have recently made serious endeavours with a view to creating a more intensive drainage system at local farms.

Despite the good crop of 1929, which compared so favourably with the partial failure

of 1928, the trade situation, following a slight improvement at the latter part of 1929 did not, at the beginning of 1930, come up to expectations. This circumstance is chiefly attributable to international competition and to the very low prices obtaining on the home market for agricultral produce.

As regards the import trade, the tendency towards *over-stocking*, especially among textile goods importers, has lately shown a tendency to decrease. Owing to the comparatively limited financial resources of the majority of the local traders import trade is largely financed by foreign credits in addition to smaller credits obtainable from local banks on the basis of customers' bills.

The general features of the Lithuanian market are :—

(*a*) A demand—chiefly on the part of the peasantry—for cheap goods;

(*b*) A comparatively small but slightly growing demand on the part of the town population for higher qualities of goods;

(*c*) A custom, which is fairly general on the part of local consumers, of buying goods on an instalment basis;

(*d*) Lack of financial resources, from which the majority of the trading community suffer;

(*e*) Intense competition on the part of foreign suppliers in respect of both prices and credit facilities.

BRITAINS ELECTRICITY.

Development of Supply.

The extent of the development attained by the public supply undertakings in Great Britain in 1928-29 was represented by the following *average* figures per head of estimated population in 1928 :—A connected load of approximately 225 watts, a maximum demand of about 92 watts, and the sale to consumers of 176 units per annum, state the Electricity Commission in their Return of Engineering and Financial Statistics of Electricity Supply in 1928-29. The total capital charged to capital account at the end of 1928-29 amounted to about £297,677,000, representing 41 per cent in respect of generation and 59 per cent in respect of transmission, distribution, etc.

Foreign Coal, Iron and Steel.

Compared with the corresponding month of last year, production of coal was markedly smaller in Germany, Poland, and the United States. The output of pig iron and crude steel was less in all the areas brought under survey. Nevertheless, except in the United States, where markets were weak, iron and steel prices ruled steady.

ALUMINIUM INDUSTRY IN CANADA.

The Aluminium Company of Canada, Ltd., is now employing approximately 1,000 men on its various operations in the vincinity of Lake St. John, Quebec. Some of these are employed at the works at Arvida, and others are working on the 22-mile branch railway line from Port Alfred or at the waterfront where bauxite ore is brought in from British Guiana. At the Company's new town of Arvida there is now an actual population of 2,000 . The operations of the Aluminium Company of Canada are of particular interest in view of the immense hydroelectric poewr development with which it is associated. At Chute a Caron on the Saguenay River near by, power plants are being erected, the ultimate installation in which will reach between 800,000 and 1,000,000 h.p. Pending the delivery of power from Chute a Caron, the Company is obtaining 100,000 h.p. of electrical energy from the Isle Maligne plant of the Duke-Price Power Company higher up the Saguenay River. Work on the dam at Chute a Caron is well advanced and power from the new generating station is expected to be available early next year, possibly by February 15th.

The Chute a Caron undertaking is a two-stage development. In the first of the two plants 250,000 h.p. will be generated. When the demand for aluminium justifies further expansion in manufacture, a canal or aqueduct will be ready to carry the water of the Saguenay River to a point two miles further downstream, releasing it at tide-water. Here a power house is to be constructed capable of a total development of about 700,000 h.p.

By that time employment on the various operations connected with the manufacture of aluminium in the lake St. John district will have increased to such an extent that there will be a new population of between 30,000 and 50,000 people. The growth of the industry, of course, is dependent upon the expansion in the demand for the metal, as the output of the Aluminium Company of Canada is destined for the world market. The uses of aluminium are, however, developing very fast, and the Arvida plant has been laid out in such a way that it can be easily extended concurrently with the further generation of electrical power. The City of Arvida is being built on a tract of land about 10 miles square, providing ample space for the expansion of the plant and of the city itself. It is interesting to note that although the townplanning of the city is the work of the Aluminium Company of Canada, the first buildings and houses having been erected by the Company itself, its

ownership of properties in the City is not being continued as a general principle. Stores are being privately operated, houses are sold, and building sites are disposed of to bona fide purchasers. Many residences and business properties have already been built by private capital.

At the aluminium plant there are three units, the first of which is equipped for the treatment of raw bauxite brought up the Saguenay from South America. The mineral is first of all put through an electric furnace to remove impurities, thus furnishing an almost pure alumina for use in the next process. The second plant produces carbon electrodes, and the third unit is the plant in which aluminium is actually made in the form of pigs for shipment to markets all over the world. The alumina is dissolved in a bath of molten cryolite, the metallic aluminium being plated out by the electric current and deposited on the bottom of the furnace. The cryolite, consisting of sodium fluoride and aluminum fluoride in fixed proportions, is at present found in commercial quantities only in Greenland.

This great industry at Arvida is a notable example of the transformation brought about by electricity in a remote district form erly devoted entirely to forest or agricultural industries. The plant is situated 22 miles from the head of navigation on the Saguenay River, the waterfront at Port Alfred being accessible by small ocean steamers coming up the St. Lawrence River, and a further 75 miles up the Saguenay itself.

FUEL ECONOMY.

The Federation of British Industries has just published Vol. IX (1930) of the Fuel Economy Review (2s. 6d.). The Review disseminates knowledge and information on all matters concerning the efficient utilisation of fuel, particularly coal. The present issue contains the following important contributions :—

" The Fuel Research Coal Survey." By F. S. Sinnatt, M.B.E., D.Sc., F.I.C.

" Coal Sampling and Analysis." By W. B. Davidson, M.A., D.Sc., Ph.D.

" The Purchase of Coal on a Calorific Basis." By The British Coal Testing Bureau.

" Low Temperature Carbonisation." By G. H. Lander, G.B.E., D.Sc., M.Inst.G.E.

" Review of the By-Product Coking Industry during the Year 1929." By G. E. Foxwell, D.Sc., F.Inst.P., F.Inst.F.

" Gas Works Practice." By T. F. E. Rhead, M.Sc., F.I.G., M.I.Chem.E., M.Inst.Gas.E.

" Industrial Uses of Town's Gas." By G. M. Walter, D.Sc., A.M.I.E.E., M.Inst. M.E.T.

" Some Notes on the Cracking of Petroleum and Synthetic Methods." By A. E. Dunstan, D.Sc., F.I.C.

" Electric Power Tariffs for Industrial Purposes." By A. P. M. Fleming, C.B.E., M.Sc., M.I.E.E.

" National Electricity Supply in Great Britain." By Harold Hobson, B.Sc., M.I.E.E., A.M.Inst.C.E.

" Industrial Electric Heating." By J. I. Bernard, B.Sc.,Tech., A.M.I.E.E.

' Fuel Economy in Open Hearth Practice." By E. C. Evans, B.Sc., F.I.C.

" Fuel Problems in the Iron Foundry." By E. Fletcher, M.I.Mech.E.

" Industrial Furnaces." By M. Van Marle, A.M.I.Mech.E.

" Steam at Solvent Products, Dagenham Dock Distillery." By H. W. Pepper.

" Automatic Temperature Control." By T. C. Moorshead, M.Am.Soc.C.E.

" The Recent Trend of Ceramic Kiln Practice." By S. R. Hind, B.Sc., A.R.C.Sc. F.I.C.

" Methods and Standards of Smoke Measurement." By J. F. Shaw, R.N. (Ret.) and T. F. Hurley, A.M.I.C.E.

" Records for Industrial Steam Raising Plants." By B. Samuels and F. Reeman.

DYESTUFFS (IMPORT REGULATION) ACT, 1920.

The following statement relating to applications for licences under the Dyestuffs (Import Regulation) Act, 1920, made during June has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee.

The total number of applications received during the month was 514, of which 434 were from merchants or importers. To these should be added 8 cases outstanding on the 31 May, 1930, making a total for the month of 522.

Of the total of 522 applications received, 487, or 93 per cent. wtre dealt with within 7 days of receipt.

ANNUAL REPORT OF H.M. INSPECTORS OF EXPLOSIVES.

The 54th Annual Report of H.M. Inspectors of Explosives (for the year 1929); pp. 51, price 9d.) has just been issued by H.M. Stationery Office, Adastral House, Kingsway, W.C.

There were no modifications in the explosives law during 1929 but Orders in Council relating to mixtures of petroleum and to calcium carbide were made. The report is now divided into, Part I, Explosives; and Part II, Petroleum, including Carbide of Calcium and Acetylene.

No deaths occurred during the year due to fire or explosion, the total number of accidents was 344, only 60 of which were in connection with the manufacture of explosives.

In the chemical work of the inspectors 430 samples were examined and of the 22 new explosives, submitted only 5 were rejected.

The report also includes a review of accidents abroad.

Proceedings and Notices of Societies

THE PHYSICAL SOCIETY.

Thursday, June 26.

Papers read :—

The Effect of Photosensitised Mercury Vapour on the Walls of Silica Vacuum Tubes. By M. C. JOHNSON, M.A., M.Sc.

An investigation is made into some phenomena occurring at the gas-solid interface in the well known experiments in which mercury atoms absorb energy from the radiation λ 2537 and then transfer that energy to other gas molecules at collision. It is shown that a combination of both condensation and liberation of gas at the surface of the apparatus must be taken into account, if the effects of irradiation of a gas mixture are to be traced by any of the usual methods of observing pressure changes. In a severely outgassed tube of mercury and hydrogen, the initial pressure-fall due to adsorption of the products of dissociation reaches a limit when a monomolecular layer having a quarter of the surface density previously obtained by electrodeless discharges in glass tubes is completed. After the completion of this saturation, a liberation of gas from the silica begins. This liberation is shown to follow a law independent of the partial pressure of H_2 but dependent on that of Hg, and on the absorption of resonance radiation by the latter. This action on the solid surface is contrasted with the more usual experiments in which the final recipient of the energy of photosensitisation is solely gaseous. Comparison may be made with other recent experiments in which atoms in high quantum states communicate their energy to solid surfaces, and also with the better known phenomena in which gas is liberated from solids by the impact of multiply charged ions.

A Sensitive Rotating-Coil Magnometer. By H. R. NETTLETON, D.Sc., AND F. H. LLEWELLYN, B.Sc., Birkbeck College.

This paper describes a sensitive rotating-coil magnetometer in which the flux due to the earth's field or to a magnet is neutralised by that due to a current passing through a fixed concentric compensating coil which forms with the rotating coil a variable mutual inductance. It shows how the first-order correcting term due to the length of the magnet may be made to vanish if the angle of contact be suitably chosen, and that the second-order correction may be eliminated by a correct choice of the dimensions of the coil. Many experiments bearing on the theory and uses of the magnetometer are described. In particular the ohm may be measured very simply, in terms of a mutual inductance and a period, by Weber's method of damping.

The Frequency Errors of Rectifier Instruments of the Copper-Oxide Type for Alternating Current Measurement. By L. HARTSHORN, D.Sc., A.R.C.S., D.I.C.

Alternating-current milliammeters containing copper oxide rectifiers possess frequency errors of an unusual type. The errors are almost independent of the instrument reading, and thus the percentage errors are inversely proportional to the current to be measured, and may be very large for small currents. It is shown that the errors are due to the capacities of the rectifiers, which, in milliammeters, are of the order 0.09μF. The peculiar nature of the errors is due to the fact that the resistance of the instrument is approximately inversely proportional to the square root of the current passing through it. It is found to be possible to compensate the frequency errors by providing the instrument with an inductive shunt, the constants of which satisfy a given relation.

A Method of Eliminating the Effects of Magnetic Disturbance in Highly Sensitive Galvanometers. By D. S. PERFECT, M.A., D.Phil., F.Inst.P., National Physical Laboratory.

The paper describes a method of making correction for the chaotic fluctuations, of magnetic origin, to which the zero of a highly sensitive moving-magnet galvanometer is susceptible. The method consists in the employment of a second galvanometer with properties adjusted as nearly as possible to identify with, and placed as close as possible to, the first. No current is passed through the second galvanometer, which acts in this respect as a dummy whose sole function is to record the zero changes. As a result of the proximity of the galvanometers, and the inter-relation of their dynamical and geometrical conditions, the recording spots of light have an approximately constant separation, in spite of the fluctuations in the position of each. The current to be measured activates one of the galvanometers, and is measured by the accompanying change in the separation of the spots. The paper also describes a compensating method of observing, in which a single beam of light is reflected in succession from the mirrors of the active and dummy galvanometers so that the emergent beam tends to remain stationary.

Papers read in title only :—

The Thermal Insulating Properties of Fabrics. By M. C. Marsh, M.A., B.Sc., A.Inst.P., British Research Association for the Woollen and Worsted Industries.

One of the chief properties of a fabric is its thermal insulation, which prevents excessive heat-loss from the body. The paper gives a critical review of methods used in the past for measuring the thermal insulating properties. These are discussed with a view to the making of a new apparatus for the study of the subject. This apparatus consists of a copper cylinder with guard-ring ends heated electrically to skin temperature. With various fabrics the expenditure of electrical energy necessary to keep it at that temperature is measured. The surrounding conditions are defined by its being enclosed in a larger concentric tube whose temperature is regulated by the circulation of water round it. The humidity of the air can also be regulated. The temperature measurements are all by thermo-couple. The weight per unit area and the thickness of the fabrics are measured. There seems to be no definite relation between thermal insulating value and weight, but there is a very approximately linear relation between thermal insulating value and thickness. A detailed analysis of the results is being made.

Classical Quantum Theory and X-ray Excitation by Canal-Rays and Alpha-Particles. By W. Band, M.Sc., Yenching University.

This paper shows, by application of the classical quantum theory and simple equations of energy, that it is not possible for canal-rays of normal experimental energy to remove K-electrons from the atoms of a metal target either by capture of by simple removal into free space. No particular mechanism is assumed, but a safe maximum for the possible transfer of momentum to the ejected electron is taken to be the transfer which takes place in a head-on collision, electric attraction being neglected. The fact that alpha-particles are observed to excite X-rays shows that the mechanism must be almost as efficient as this. The process of capture is shown to be no more probable than that of simple removal into free space. The minimum energy for canal-rays and the minimum velocity for alpha-particles, for K-radiation from copper, are calculated as at least 72 million volts and 1.7×10^9 cm./sec. respectively. The theory claims to give a satisfactory explanation of all the experimental data so far available.

Diffusion from an Infinite Plane Sheet Subject to a Surface Condition; With a Method of Application to Experimental Data. By A. T. Mackay.

The solution of the partial-differential diffusion equation for the infinite plane sheet is found by operational methods, subject to a surface condition analogous to Newton's law of cooling. By use of the fact that the area between the quantity-axis, the theoretical quantity/time curve and its asymptote is finite, a method of curve-fitting suitable to the case is suggested. To facilitate the application of the method to experimental data two numerical tables are appended.

Intensity Modifications in the Spectrum of Mercury. By S. Tolansky, B.Sc., Fellow of Armstrong College.

GEOLOGICAL SOCIETY.

June 11.

Prof. E J. Garwood, M.A., Sc.D., F.R.S., President, in the chair.

Alexander Hamilton Rice, M.A., M.D., 901, Fifth Avenue, New York City, was proposed as a Fellow of the Society.

Prof. Paul Lemoine, Paris; and Prof. Gustaaf Adolf Frederik Molengraaff, Delft, were proposed as Foreign Members of the Society.

The following communication was read : *Land Bridges Across the Atlantic and Pacific Oceans During the Kainozoic Era.* By the late Dr. Hermann von Ihering. (Translated by Frau E. M. Schütze-Richter and F. N. Ashcroft, M.A., Treas.G.S. ; communicated by Prof. J. W. Gregory, LL.D., D.Sc., F.R.S., V.P.G.S.).

The value of Zoogeography as the pathfinder for Geology is being more widely recognised. The Author summarises some of the conclusions from his life's study of the biological relations of South America as to the history of the Atlantic and Pacific Oceans. He agrees in general with the conclusions in the Presidential Address to the Geological Society for 1929 on the "History of the Atlantic." He considers that the North and the South Atlantic were separated until the Miocene Period by land that extended from West Africa to the Antilles and South America. South of that land there was some connection between the seas of Egypt and South Africa. The faunas of the North and the South Atlantic first intermingled in the Upper Miocene Period.

The argument for the separation of South America and Africa by drift based on the shape of South America is invalid, as that shape was developed only in the Middle Quaternary. Previously the South Atlantic was a warm sea, and mangroves lived as far south as the Rio Negro : earth-movements then admitted a cold current, and the mangroves were driven 12° northwards, the change of climate exterminating the great Argentine Edentates.

The Pacific Basin in Upper Cretaceous time was traversed by a land for which is suggested the name "Archipacifis." Its eastern parts extended along western North America as Schuchertland, and along South America as Burckhardtland. The three sections were each a centre of mammalian development. The *Notostylops* fauna and the Dakota flora reached Patagonia by way of Archipacific. The first immigration was earlier than the advent of the Creodonts.

Archigalenis is a remnant of Archipacific, and was the only Kainozoic trans Pacific land-bridge : it lasted until the end of the Miocene Period. To land west of America was due the range of the American Edentates, the intermingling in Patagonia of the northern and southern floras, and the occurrence in Mexico of an outlier of the southern Crayfish and their parasites.

The view that the Bears had reached South America by Miocene time cannot be maintained, as it was based on fossils from the Pampas Formation having been accepted as from the Entrerios Beds. The isolation of Patagonia from Brazil until the Middle Miocene is now proved by deep bores under the pampas.

Among other evidence of a land-connection across the Southern Pacific between Australia and Patagonia, the case may be cited of *Prothylacinus*, which, with its eight incisors, is a carnivorous Marsupial, and not a Creodont.

Slides illustrating frost stone-packing on the shores of Loch Lomond in relation to stone-polygons were exhibited by Prof. J. W. Gregory.

June 25.

The Geology of the Tertiary Igneous Complex of Ardnamurchan. By J. E. Richey, M.C., B.A., F.R.S.E., F.G.S.

Mr. J .E. Richey and Mr. G. Torkington exhibited a Geological Model of the Mourne Mountains (Ireland).

INSTITUTE OF CHEMISTRY.

Beilby Memorial Awards.

As a memorial to the late Sir George Beilby, the distinguished chemical engineer, who died in 1924, a fund was collected in 1926 from the interest on which, at the discretion of the administrators, awards are to be made from time to time to British investigators in science, to mark appreciation of distinguished original work carried out over a number of years, preference being given to investigations relating to the special interests of Sir George Beilby, including problems connected with fuel economy, chemical engineering, and metallurgy.

The administrators of the fund have announced the award of £250 each to Dr. Guy Dunstan Bengough, of the Chemical Research Laboratory, Teddington, and Mr. Ulick Richardson Evans, of Cambridge.

Guy Dunstan Bengough was born in 1876 and educated at Malvern College and Cambridge University, where he took his B.A. degree in 1898, and M.A. in 1901. He studied for two years at the Royal School of Mines, South Kensington, and subsequently spent several months in the late Sir Willliam Roberts-Austen's research laboratory at the Royal Mint. He started the Department of Metallurgy at the Sir John Cass Technical Institute where he stayed for two years, resigning his position to become metallurgist and assayer to a Burmese Tin Syndicate. On returning to this country

he was appointed lecturer in Metallurgy at Birmingham University, and in 1907 took charge of the Metallurgical Department at Liverpool University. His first research work was done at Liverpool and consisted of metallographic investigations on the annealing of metals and on the tensile properties of alloys at high temperatures. In some of this work he was associated with O. F. Hudson and D. Hanson. In 1911 he published the first of a series of reports to the Corrosion Research Committee of the Institute of Metals. This series was largely concerned with the corrosion of condenser tubes and was continued till 1924, when the 7th Report was published in collaboration with R. May. In 1913 he took his D.Sc. degree at Liverpool University. In September, 1914, he was gazetted to the Royal Garrison Artillery, T.F., and in 1915-16 was Captain and Adjutant to the C.R.A. Mersey lefences. In the latter year he was seconded or research work at the request of the Admiralty. In 1924 he left the service of he Institute of Metals to take up an apointment under the Department of Sciensfic and Industrial Research, and in 1926 e published in conjunction with J. M. tuart an account of the anodic process for ie protection of aluminium and certain ght alloys against corrosion. Patents for is process had already been granted to the o authors and the rights assigned to His ajesty's Treasury; the process has come to use all over the world, wherever aircraft e made, and has been found useful for ch diverse purposes as the protection of tificial limbs, surveying instruments and tal rollers. In 1927 he was appointed incipal Assistant at the Department's emical Research Laboratory, Teddington, ere he is now in charge of the Corrosion search section of the laboratory, in which reat variety of corrosion problems are ng investigated. In 1928 he was invited give a special lecture on corrosion before 8th Congress of Industrial Chemistry at sbourg, and to write the article on coron in the latest edition of the *Encyclo-ia Britannica*. In conjunction with J. Stuart and A. R. Lee he has recently lished a series of papers in the *Proceed- of the Royal Society* and elsewhere on theory of corrosion in the light of quantive measurements.

lick Richardson Evans was born March 1889, at Wimbledon, and was educated larlborough College (1902-1907), and at nbridge University (1907-1911), where rained an "Exhibition" at King's College: he took his B.A. degree in 1910, and M.A. in 1914. During 1913 and 1914 he was associated with Dr. E. K. Rideal in electrochemical consulting work in London. From August, 1914 until 1919 he was in the Army, first with the infantry and later attached to the signal services of the British and Indian armies. Returning to Cambridge University in 1920, he devoted three years to writing a four-volume book on "Metals and Metallic Compounds." Since its publication in 1923, he has been occupied mainly with research work on the Corrosion and Passivity of Metals, and on the properties of the thin oxide films frequently present on the surface of metals; these films—which may profoundly influence the behaviour of the metals—are usually invisible, although—as Mr. Evans showed—they become visible when removed from the brightly reflecting basis. On these subjects he has published about 30 scientific papers, the majority of which have appeared in the *Journals* of the Institute of Metals, Faraday Society, Chemical Society, and Society of Chemical Industry; communications have also been published in the *Proceedings* of the Royal Society, *Nature*, and several other journals. Mr. Evans is also the author of several papers on other scientific and technical subjects, including "Recrystallisation in Metals," "Colloid-chemistry," "Fuel Cells," and "Electro-tanning." Much of this work has been conducted alone, but there have been joint papers with E. K. Rideal, L. L. Bircumshaw, M. Cook, R. T. M. Haines, L. C. Bannister J. Stockdale, S. C. Britton, and others. In 1924 appeared the first edition of Mr. Evans' book on the "Corrosion of Metals"; the second edition, greatly altered owing to the advances made in the intervening two years, was published in 1926; this book has been translated into German (1926), and French (1928). Considerable interest in Mr. Evans' work has been shown abroad, particularly in the United States. He contributed papers (in each case at the request of the Organisers) to three "Symposia" on Corrosion held in America in the years 1924, 1925 and 1927; and in February, 1929, by invitation of the American Institute of Mining and Metallurgical Engineers, he visited New York to deliver the Annual Lecture on Metals; this was followed by a lecture tour in the States. Mr. Evans is a member of the Corrosion Committee of the Department of Scientific and Industrial Research, and of the Corrosion Committee of the Department of Scientific and Industrial Research, and of the Corrosion Committee of the Iron and

Steel Institute: he was recently elected the "Honorary Corresponding Member" for Great Britain of the German "Reichsausschuss für Metallschutz."

The administrators of the fund are the Presidents, Treasurers and Secretaries of the Institute of Chemistry, the Society of Chemical Industry, and the Institute of Metals.

SUCCESS OF THE ACHEMA VI.

On 22 June the Jubilee-Achema, the Achema Exhibition of Chemical Apparatus held at Frankfort-on-Main, came to an end. It is quite obvious, even to-day, that the Achema VI has been an enormous success for all who took part in it: for the Deutsche Gesellschaft für chemisches Apparatewesen E.V., which instituted the Exhibition, it has led to a widening of its field of activity, for the exhibitors it has been invaluable with reference to their technical and commercial interests.

Roughly 40,000 visitors passed through the exhibition gates. Experts from all parts of the world poured into Frankfort, and their stay was amply rewarded. The quest for information was great, many new business relations were established but, most remarkable of all was the fact that a considerable number of sales were recorded, for such a result was hardly to be anticipated from a technical exhibition of the class of the Achema VI.

The place and date of the next Achema, which in all probability will take place in three years' time, have not yet been fixed. Invitations have been received from several towns but first of all the question of available space must be considered before a decision can be made. The space requirements of such an immense exhibition naturally increase enormously from year to year and there are relatively few places in Germany which are able to satisfy such demands.

The imposing picture of the Achema VI is undoubtedly an example of the inner force and power of advancement possessed by our technical industry.

NOTICES OF BOOKS.

A Comprehensive Treatise on Inorganic and Theoretical Chemistry. By J. W. MELLOR, D.Sc., F.R.S. Vol. X. S, Se. Pp. X + 958. London: Longmans, Green & Co., 39, Paternoster Row, E.C. 1930. Price 63s.

The same characteristic thoroughness which was observed in the nine volumes of Mellor's *Comprehensive Treatise*, are observable in the section on Sulphur and Selenium, which has just been published. Two-thirds of the space is devoted to the better-known element and its wide range of compounds, and it can be said without hesitation that no compound of either element has escaped the author's attention for the literature has been searched so exhaustively that it is doubtful if any article bearing on these elements or their compounds has not been included in the long lists of references to be found at the end of each section.

Dr. Mellor has so often been congratulated—in these columns and elsewhere—for the excellence of his *Comprehensive Treatise on Inorganic and Theoretical Chemistry* and on his other publications, that it would be superfluous to reiterate the praise already given. When his enormous task is completed the volumes will represent practically the whole of our chemical knowledge down to the moment of writing. The value of the work cannot be over-estimated. Certainly nothing ever previously published has approached the present *Treatise* in completeness.

Qualitative Analysis. By WILLIAM BRIGGS, LL.D., M.A., B.Sc., and R. W. STEWART, D.Sc. Revised by D. R. Snellgrove, Ph.D., M.Sc., A.I.C. Second Edition. Pp. xii + 171. London: W. B. Clive, University Tutorial Press, High Street, W.C. 1930. Price 4s.

This well-known textbook is intended to meet the needs of candidates for the Intermediate Science examinations of the universities and is written so that it can be used for higher work in schools and technical institutes. In general the methods and analytical procedure given leaves nothing to be desired but a student working through Table VI in separating the metals of Group IV (p. 124) might well be involved in difficulties in separating zinc and manganese, since he is told to treat the mixed precipitates in *cold* HCl and nothing is said about *boiling off the* H_2S before adding NaOH. With this small exception the book can be cordially recommended to science masters for use in qualitative chemical analysis.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

18,631.—I. G. Farbenindustrie Akt.-Ges.—Production of anthraquinone derivatives. June 18.

18,671.—I. G. Farbenindustrie Akt.-Ges.—Manufacture of N-substituted 2-alkoxy-6-halogen 9-aminoacridines. June 18.

18,507.—Institut fur Physikalische Grundlagen der Medizin.—Carrying out chemical reactions. June 17.

Specifications Published.

305,674.—I. G. Farbenindustrie Akt.-Ges.—Process for the manufacture of readily soluble acyl celluloses yield-clear solutions.

306,097.—I. G. Farbenindustrie Akt.-Ges.—Process for the manufacture of alihpatic carboxylic acids from aqueous solutions thereof.

307,306.—I. G. Farbenindustrie Akt.-Ges. Process for the manufacture of anthraquinone derivatives.

Abstract Published.

328,572.—Acetic anhydride. (Akt.-Ges. für Stickstoffdunger; 14, Georgesplatz, Cologne, Germany.

Acetic anhydride is produced by reacting phosgene with liquid acetic acid in presence of a suitable catalyst. Suitable catalysts are compounds of metals whose chlorides are converted to acetates by boiling with acetic acid and whose acetates easily lose acetic acid, such as metals of the second and third groups of the periodic system, especially magnesium calcium barium strontium and aluminium, also metals of the iron group, and cerium and other metals of the rare earths; the compounds may be oxides, or salts of an inorganic or organic acid. In examples, acetic acid is mixed with anhydrous aluminium chloride or magnesium acetate, heated to boiling, and phosgene is passed in; the gases evolved may be passed through cooled acetic acid to recover entrained acid.

Printed copies of the full published specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2., at the uniform price of 1/- each.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

LIMBUX.

513,281.—Chemical substances used for agricultural, horticultural, veterinary and sanitary purposes.—The Buxton Lime Firms Co., Ltd., Imperial Chemical House, Millbank, London, S.W.1. June 25.

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NOTICE TO AUTHORS & CORRESPONDENTS

Contributions for publication either as original articles or in the correspondence columns are welcomed by the Editor of *The Chemical News*.

They must be accompanied by the contributors' full names and addresses, not necessarily for publication, but as an indication of good faith. If a reply is needed or if it is desired that a manuscript which is not accepted for publication be returned, a stamped addressed envelope should be enclosed.

No notice can be taken of anonymous letters.

THE PROGRESS OF NICKEL DEPOSITION IN RECENT YEARS.*

By
D. J. MACNAUGHTON, A.Inst.P., A.I.E.E., AND R. A. F. HAMMOND, B.Sc., A.R.C.Sc., A.I.C. (Research Department, Woolwich).

INTRODUCTION.

The object of this paper is to review briefly the knowledge that has been acquired during recent years concerning the conditions that determine the more important properties of nickel deposits, and the influence of this knowledge upon the commercial development of nickel deposition.

EARLY HISTORY OF NICKEL PLATING.

The deposition of nickel was preceded by that of copper. In 1839 Jordan was depositing copper from copper sulphate solutions on to graphited surfaces, and establishing the art of electrotyping. Various unrecorded experiments were probably made to deposit nickel from the corresponding nickel sulphate solution, but satisfactory results from this solution were not readily obtained and several years passed before it was found that the metal could be deposited with relative ease and in brilliant form from a solution of nickel ammonium sulphate.

The development of nickel plating did not, however, commence until about 1870. By this time nickel of better quality was obtainable, the electric accumulator had been discovered and developed, and the dynamo—evolved from the laboratory experiments of Faraday—had advanced from an early form with permanent magnets to the self-excited type of machine. The commercial application of nickel deposition then rapidly developed, but electrodeposition did not engage the attention of scientific investigators to any marked extent during the nineteenth century. Such researches as were carried out were contributory chiefly to an understanding of the general principles underlying electro-chemical processes, rather than to a knowledge of the precise factors that control the properties of a particular deposit. Nevertheless, considerable information was obtained by investigators working along empirical lines and, when commercial development of the art took place, much miscellaneous knowledge was acquired by practical platers.

In 1869 Adams patented the use of nickel ammonium sulphate in conjunction with

* Reprinted from the *Journal of the Electroplaters' and Depositors' Technical Society.*

cast nickel anodes containing a considerable percentage of iron. A company acquired his patent and rapidly developed the process throughout the U.S.A. Later, this process was introduced into England, a plant being installed in Birmingham.

As the process expanded in use other investigators obtained patents. Of these, probably the most important was that of Weston, who in 1879 established his claim for the use of boric acid, which made solutions of nickel sulphate—without the addition of ammonium sulphate—suitable for plating. Other solutions did not prove to be so satisfactory. In 1889 Watt described the results of plating experiments with about fifty nickel baths in which acetates, benzoates, chlorides, citrates, lactates, tartrates, formates and other salts were used. None of these solutions proved to be as satisfactory as the sulphate bath, although many of the compounds he used were employed by various platers as additions to the sulphate bath, producing complicated solutions which were claimed to be of superior merit.

In general, however, preference was maintained for the nickel ammonium sulphate solution with cast nickel-iron anodes, so that, when Adams[1] stated in 1906 that in this respect the art of electrodeposition of nickel had not advanced beyond the stage reached in 1870, he was to a large extent correct.

However, rapid advances were shortly to be made.

Improvements in the Technique of Nickel-Plating in the XXth Century.

(1) *Increasing the Rate of Deposition.*

With the nickel ammonium sulphate solution operated at ordinary temperatures, it was not considered practicable to use a higher rate of deposition than about 5 amp. per sq. ft. Using higher temperatures, it was found possible to increase the rate of deposition but, owing to the difficulties of heating on a large scale, this was not generally favoured. A suitable solution having a higher nickel content was sought, and by 1908[2] it was becoming increasingly common to replace a portion of the nickel ammonium sulphate by the more soluble nickel sulphate. This secured a moderate increase in the nickel content of the bath, but a greater advance in this direction was obtained by the solution patented by Weston, containing nickel sulphate and boric acid. Full advantage could thus be taken of the relatively high solubility of nickel sulphate.

It was not possible, however, to use the high rate of deposition thus rendered practicable without improved anode corrosion. But in this connection it had been pointed out by Bancroft[3] in 1906 that the addition of a relatively small amount of a soluble chloride—such as nickel or potassium or sodium chloride—would greatly improve anode corrosion. Solutions containing the three constituents—nickel sulphate, boric acid and a soluble chloride—thus came into use and found increasing favour owing to the higher rates of deposition that were possible. It was shown by Watts[4] that remarkable current densities could be employed with such solutions, particularly at high temperatures. Using solutions containing 240 grm. per litre of nickel sulphate, 20 grm. boric acid, 20 grm. nickel chloride, he obtained in the laboratory good deposits at 200 amp. per sq. ft. and over. It was subsequently found that, even under commercial conditions, current densities of 50-100 amp. per sq. ft. were practicable.

(2) *Control of the Solution.*

(*a*) *Acidity.* The increasing departure from the traditional methods that had been in vogue since 1870 was followed by a demand for more careful control of the conditions of deposition. In 1916 Hogaboom[5] emphasised the desirability of developing improved methods for the determination of the acidity of the solution. The use of litmus and Congo red papers was proving too crude a method of control in view of the greater output of work from solutions of high nickel content. Electrochemists interested themselves in the matter and attempts were made to determine the hydrogen ion concentration in nickel-plating solutions by potentiometric methods, using the hydrogen electrode; but this method, besides being too complicated for general use, proved also to be unreliable.

[1] Adams. "Development of the Nickel Plating Industry." *Trans. Amer. Electrochem. Soc.*, 1906, IX, pp. 211-217.

[2] Brochet. "Manuel Pratique de Galvanoplastie." 1908, p. 313.

[3] W. D. Bancroft. Discussion on Adams' paper. *Loc. cit.*

[4] O. P. Watts. "Rapid Nickel Plating." *Trans. Amer. Electrochem. Soc.*, 1916, XXIX, pp. 395-400.

[5] G. B. Hogaboom. "Some Unsolved Problems of the Electroplater." *Trans. Amer. Electrochem. Soc.*, 1916, XXIX, pp. 369-375.

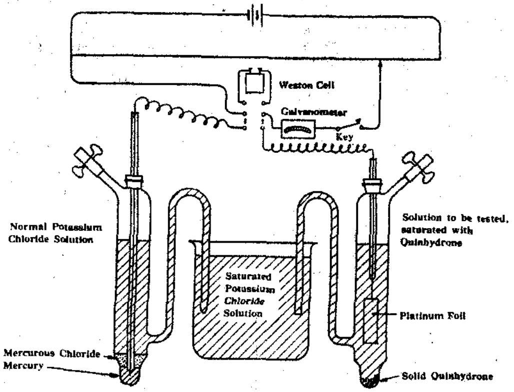


Fig. 1—Apparatus for determination of the pH *by means of the Quinhydrone Electrode. This method is suitable for the specially accurate estimation of the* pH *of Nickel-Plating Solutions.*

Fortunately, about this time, as a result of the work of Sörensen and others, improved colorimetric methods for the determination of acidity had been greatly developed. Thompson[6] found that these methods were suitable for nickel-plating solutions and in 1922 he described a simple method of applying them. He also introduced to platers Sörensen's method of expressing the acidity in terms of *p*H, and recommended Brom-Phenol Blue, Methyl Red and Brom-Cresol Purple to cover the ranges of *p*H 3.1-5, 4.05-5.95 and 5.3-7.2 respectively.[7]

At a later date, electrometric methods for the determination of the *p*H were improved, as a result of the introduction of the quinhydrone electrode (See Fig. 1), and were found to be more accurate than colorimetric tests.

The improvement in the methods for determining the *p*H of nickel depositing solutions led to more precise knowledge as to the most suitable range of acidity. The most satisfactory *p*H range in which to operate nickel solutions was recommended by various investigators as lying between *p*H 5.5 and 6.5. The maintenance of the *p*H within the desired range is dependent upon securing a constant balance between anode and cathode efficiencies. The cathode efficiency in nickel deposition is always less than 100 per cent. This means that a certain amount of hydrogen ions is continuously being discharged at the cathode, with the tendency that their concentration in the solution is lowered, and the *p*H increased. If, as is frequently the case, in solutions containing chlorides, the anode efficiency is about 100 per cent., no corresponding formation of hydrogen ions occurs at the anode, so that with continued deposition the solution gradually increases in *p*H. Under certain conditions, however, the anode efficiency may be less than 100 per cent., and in these circumstances hydrogen ions are set free at the anode. With solutions relatively free from impurities and equal anode and cathode efficiencies, the *p*H of the solution remains constant. If, however, the anode efficiency is lower than that of the cathode the *p*H value of the solution tends to decrease. By measurement of the *p*H at regular intervals, the esixtence of any such tendencies can be determined; suitabe remedies can then be applied, such as the introduction of chlor-

[6] M. R. Thompson, "The Acidity of Nickel Plating Soutions." *Trans. Amer. Electrochem. Soc.*, 1922, XLI, pp. 333-358.

[7] For a full explanation of the term "pH" together with a detailed description of methods for its determination, see our Publication L.2, "The Control of Acidity in Nickel-Plating Solutions."

ides into the solution, adjustment of the areas of the anodes or addition of acid to the solution.

It was found that solutions of different compositions differ in the degree to which the pH is changed by additions of equal amounts of acid or alkali, and this degree of resistance to change in pH is commonly known as the "buffer characteristic" of the solution. A study of a variety of solutions by Blum[8] and by Thompson[9] showed that whereas a solution of nickel sulphate is almost unbuffered, the addition of a slightly dissociated acid such as boric, citric or acetic acid buffers the solution. The value of ammonium sulphate as a buffering constituent was shown later.[10] The relatively unbuffered nickel sulphate solution is unsatisfactory for deposition, and it was established that all satisfactory nickel depositing solutions are at least moderately well buffered.

(*b*) *Throwing Power.* Up till 1922 very little work had been directed towards elucidating the fundamental principles which determine the manner in which a metal is distributed when deposited upon an article of complicated shape. In 1923 Blum and Haring[11] analysed the factors that influence the throwing power in copper depositing solutions, and showed that the property was largely determined by (1) the rate of change of cathode potential with current density, (2) the conductivity of the solution, (3) the cathode efficiency at different current densities.

In the case of nickel-plating solutions it was found possible to use this information to ascertain the relative value of different types of solution and of the various additions which have been proposed from time to time. For example, Haring[12] established for nickel deposition that any conditions that decreased the ratio of nickel ions to hydrogen ions in the cathode film decreased the throwing power and *vice versa*. The throwing power in moderately buffered solutions, such as those consisting of nickel sulphate and boric acid solutions, and nickel ammonium sulphate solution, was found to be better than in highly buffered solutions such as those containing nickel sulphate, boric acid and a fluoride. A high concentration of nickel salt and the presence of a chloride in the solution were found to favour good throwing power.

(*c*) *Impurities.* It was known that many materials are liable to be present in nickel baths which have not been deliberately added but which nevertheless affect the conditions of deposition. In view of the importance of securing control it was necessary that such ingredients, unless proved to be advantageous, should be suitably limited in amount.

In the salts of nickel supplied to platers, impurities not infrequently present were copper, zinc and iron. A study of the influence of these impurities[13] in the amounts likely to be present showed that copper tended to plate out in such a way as to give rise to rough nickel deposits, zinc to cause the production of bright and streaky nickel deposits, and iron to have an effect which was largely determined by the pH of the solution; at low pH values, for example, it was found that iron is co-deposited with the nickel, whereas in the usual pH range—5.5 to 6.5—it tends to become precipitated as hydroxide, which is liable to contaminate the deposit[14]. Limits for these impurities in nickel sulphate were suggested as follows:

Zinc ...	Not more than 0.05 per cent.
Copper	,, ,, ,, 0.02 ,, ,,
Iron ...	,, ,, ,, 0.1 ,, ,,

(*d*) *Anode Corrosion.* From the anodes other impurities are liable to find entrance into the solution and to affect the deposit. The problem of fixing limits for impurities in anodes is, however, more complicated than for the salts.

[8] W. Blum. "The Use of Fluorides in Solutions for Nickel-Plating." *Trans. Amer. Electrochem. Soc.*, 1921, XXXIX, pp. 459-479.

[9] *Loc. cit.*

[10] D. J. Macnaughtan and A. W. Hothersall. "The Hardness of Electrodeposited Nickel." *Trans. Faraday Soc.*, 1928, XXIV, pp. 387-400.

[11] W. Blum and H. E. Haring. "Current Distribution and Throwing-Power in Electrodeposition." *Trans. Amer. Electrochem. Soc.*, 1923, XLIV, pp. 313-345.

[12] H. E. Haring. "Throwing Power, Cathode Potentials and Efficiencies in Nickel Deposition." *Trans Amer. Electrochem. Soc.*, 1924, XLVI, pp. 107-131.

[13] M. R. Thompson and C. T. Thomas. "The Effect of Impurities in Nickel Salts used for Electrodeposition." *Trans. Amer. Electrochem. Soc.*, 1922, XLII, pp. 79-94.

[14] M. R. Thompson. "The Effect of Iron on the Electrodeposition of Nickel." *Trans. Amer. Electrochem. Soc.*, 1923, XLIV, pp. 359-393.

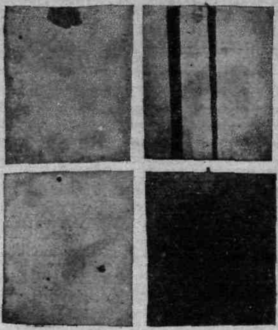
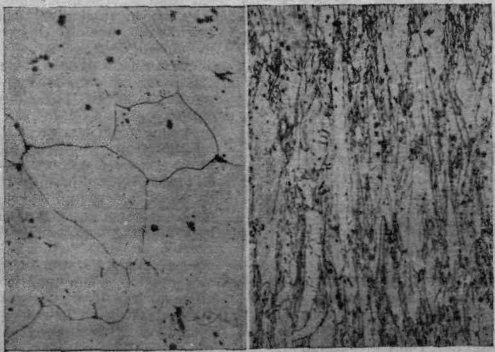


Fig. 2. The two left-hand photographs show deposits from a Nickel Bath uncontaminated by Zinc. The black streaks visible in the upper right-hand photograph resulted from the addition to the bath of 1 grm. per litre (0.16 oz. per gallon) of Zn as zinc sulphate. The complete blackening shown in the lower right-hand photograph was produced by the addition of 1.5 grm. per litre (0.24 oz. per gallon).

In solutions not containing chloride additions it is not possible to use nickel of high purity owing to the tendency of such anodes to become passive under ordinary conditions of deposition. The basis of the 1870 patent of Adams was the use of cast nickel anodes containing 6-10 per cent. iron, which was assumed to be necessary to render the anodes soluble in the chloride-free solution then used. Anodes containing this impurity together with carbon and frequently tin were in general use until recently. In 1924 Thomas and Blum[15] carried out plating trials with specially sand-cast and chill-cast nickel anodes of different compositions. They found (1) that in solutions free from chlorides the solubility of a cast anode depends on the carbon content, which for high solubility should be at least 1.4 per cent. and (2) that the carbon is mostly present as graphite, which being distributed in the form of fine flakes in sand-cast anodes causes these to corrode in a more satisfactory manner than chill-cast anodes in which the free carbon is in the nodular form.

Iron and tin did not markedly improve anode corrosion, and as they added insoluble matter to the bath, were undesirable constituents. These investigators recommend for solutions free from chlorides the



× 100 CAST NICKEL ANODE — × 100 ROLLED NICKEL ANODE

Fig. 3—Photomicrographs showing the Crystal Structure of typical Nickel Anodes.

following specification for sand-cast anodes :

Carbon ...	Not *less* than 1.52 per cent.
Copper ...	,, more ,, 0.25 ,, ,,
Sulphur ...	,, ,, ,, 0.1 ,, ,,

[15] C. T. Thomas and W. Blum. "Nickel Anodes for Electroplating." *Trans. Amer. Electrochem. Soc.*, 1924, XLV, pp. 193-214.

The high percentage of carbon necessary to secure satisfactory anode corrosion in such solutions, however, constitutes a strong reason for the abandonment of such anodes.

In 1916 Hammond[16] showed that 15 grms. per litre of nickel chloride was adequate to secure satisfactory solubility of nickel anodes of high purity under ordinary plating conditions. The use of solutions containing chlorides in conjunction with anodes of high purity subsequently developed to an increasing extent.

Differences of opinion have been held as to whether the purer type of anodes should be used in the cast or rolled condition, and if rolled, whether hot rolled or cold rolled, or rolled and then annealed. In 1921 Madsen[17] stated that, as the result of numerous experiments, he concluded that cold rolled anodes were superior in solubility to hot rolled anodes.

Apart, however, from the question of solubility, the uniformity of corrosion is of importance, as irregular corrosion tends to increase the amount of metallics in the slimes.

In 1928 Hogaboom[18] stated that the rate of corrosion of an anode is influenced by the size of the crystals. In the cast condition the crystal size may vary greatly, so that irregular corrosion is likely to occur in use. By rolling cast anodes greater uniformity of crystal structure is secured. Still greater uniformity may be obtained by annealing after rolling at a temperature just above 800° C., and such a treatment is stated to yield a greatly improved anode.

Another line of development in the manufacture of the purer types of anode consists in the introduction of a small proportion of nickel oxide into the nickel just before casting.[19] The presence of the oxide favours corrosion. Anodes of this type are now being used on a large scale.

(To be continued.)

[16] L. D. Hammond. "The Electrodeposition of Nickel." *Trans. Amer. Electrochem. Soc.*, 1916. xxx, pp. 103-131.

[17] C. P. Madsen. "Ductile Electrolytic Nickel." *Trans. Amer. Electrochem. Soc.*, 1921, xxxix, pp. 483-490.

[18] G. B. Hogaboom. "Nickel Anodes." *Brass World*, 1928, xxiv, pp. 18-19.

[19] C. P. Madsen. "Means and Method for Electrodepositing Nickel, Cobalt or Nickel Alloys." *Brit. Pat.* 244166, 1924.

THE PROPERTIES OF ARACHIN AND CONARACHIN AND THE PROPORTIONATE OCCURRENCE OF THESE PROTEINS IN THE PEANUT.

By D. Breese Jones and Millard J. Horn

The importance of peanuts both as an article of human food and as a feedstuff is becoming generally recognised. The high nutritive value of the proteins of peanuts has been shown in the previous publications from this laboratory, and elsewhere. Peanut press cake has been shown to be an excellent protein concentrate to supplement rations containing proteins deficient in essential amino acids.

Knowledge regarding the proteins of the peanut is limited almost entirely to that contained in an early publication of Ritthausen (6), and in a more recent series of articles from the Bureau of Chemistry and Soils of the United States Department of Agriculture. Ritthausen extracted oil-free peanut meal with various saline and alkaline solutions and precipitated the globulin fraction by dilution with water, and by acidification with acetic and sulphuric acids. No evidence was obtained indicating the presence of more than one globulin. In the investigations carried on in the Bureau of Chemistry, Johns and Jones, in 1916, isolated from peanut meal two gobulins which they named arachin and conarachin. The arachin was precipitated from a 10 per cent sodium chloride extract of the meal (*a*) by dilution with water, (*b*) by making the salt extract 20 per cent saturated with ammonium sulphate, and (*c*) by saturating the salt extract with carbon dioxide. The more soluble conarachin was precipitated by dialyzing the filtrate from the arachin, or by saturating it with ammonium sulphate. Arachin was obtained in much the larger quantity and different from conarachin in having only about one-third as much sulphur, and in containing less basic nitrogen. Besides arachin and conarachin a trace of a substance having the properties of an albumin was isolated. The quantity, however, was so small that its nature could not be definitely established. No evidence was obtained indicating either the presents or the absence of proteins of the prolamin or glutelin type. Later, studies of the chemical composition of arachin and conarachin were made, including a study of the distribution of the nitrogen by the Van Slyke method, the determination of certain amino acids by colorimetric methods and the hydrolysis of arachin with subsequent determination of the

resulting amino acids by the Emil Fischer ester method.

In these studies, attention was confined chiefly to the chemical character of the two globulins. There were no quantitative data regarding the proportion in which arachin and conarachin occur in the peanut. The method available for the isolation and preparation of trotcins in a condition satisfactory for their characterization usually require the sacrifice of yeilds for the sake of purity. Even though the amino-acid composition of the individual proteins in a given food product is known, it is obviously impossible to estimate the percentages of amino acids in the whole material unless data are available regarding the relative proportions in which the proteins occur. This is an important consideration from a practical standpoint. The dietitian or animal husbandman is chiefly interested in knowing how much of the nutritionally essential amino acids the whole food or feedstuff contains rather than the percentages of amino acids in the individual proteins. The investigation described in this paper was undertaken to obtain more information regarding the physical properties of arachin and conarachin, as well as further evidence showing whether peanuts contain proteins other than globulins, and whether they contain nitrogen of a nonprotein nature.

Preparation of the Meal and Extraction of the Globulins.

Raw shelled Virginia peanuts were ground in an electrically driven mill, and most of the oil was removed by two or three extractions with petroleum ether. The meal was again ground as fine as possible, and the residual oil removed by repeated extractions of ethyl ether. The meal thus prepared contained 7.36 per cent of nitrogen, equivalent to 40.48 per cent of protein (N × 5.5, the conversion factor for peanut proteins).

Fifty grams of the meal was shaken for three of four hours in a 500 c. c. centrifuge bottle with 250 c. c. of 10 per cent sodium chloride solution. The suspension was then centrifuged, and the supernatant liquid decanted. The residue was repeatedly extracted in a similar manner with fresh portions of salt solution until no more nitrogen was removed. The extracts were combined, filtered, and diluted to 2 liters with 10 per cent salt solution. This is hereafter referred to in this paper as a extract. For quantitative work on the peanut proteins it is necessary to use freshly prepared extracts. After the saline extracts have stood for about three days, even in an ice box, changes take place, resulting in the precipitation of a light material and the formation of nonprotein nitrogen, which increases in quantity as the extract continues to stand. After a 10 per cent sodium chloride solutions of pure arachins had stood us an ice box for several days is was found that material coagulating at three different temperatures could be separted from the saline solution. The precipitation limits with ammonium sulphate were also changed. With an old solution of arachin a clear-cut separation between arachin and conarachin could not be effected. Small quantities of material separated at 50 per cent, 60 per cent, and 70 per cent of saturation with ammonium sulphate. Nitrogen determinations on aliquots of the extract showed that it contained 86 per cent of the total nitrogen in the meal.

Preliminary Tests.

Coagulation tests were made by heating 10 c. c. portions of the extract in a test tube immersed in a water bath, the temperature increasing at the rate of about 4° C. per minute. The first coagulum appeared at 80° C. This was filtered off, and the clear filtrate on further heating became somewhat cloudy at 94°, but no coagulation occurred even when the filtrate was heated to boiling temperature. When the hot solution was slightly acidified with acetic acid, however, a copious precipitate formed.

Precipitation tests with ammonium sulphate likewise showed no evidence of the presence of more than two proteins. Measured quantities of a saturated solution of ammonium sulphate were successively added to 10 c. c. of the extract so as to raise the concentration of ammonium sulphate in the extract by increments of 10 uer cent of saturation. After each addition any precipitate formed was filtered off, and another portion of ammonium sulphate added to the clear filtrate. The first appearance of cloudiness occurred at about 20 per cent of saturation, and a gradual increase in the precipitate formed was obtained up to 40 per cent of saturation. Beyond that there was no precipitation until a fraction separated between 70 and 80 per cent saturation. Continued addition of ammonium sulphate to the filtrat from this fraction up to complete saturation caused no further precipitation. The final stage in completely saturating the filtrate was accomplished by addition of solid ammonium sulphate.

From the results of the coagulation and precipitation tests it was concluded that the extract contained only two proteins.

Properties of Arachin.

When separated from a salt solution by precipitation with ammonium sulphate, or by dilution with water, arachin settles out as a sticky, heavy precipitate. By stirring this precipitate with gradually increasing concentrations of alcohol, and finally dehydrating it with absolute alcohol and ether in the usual way, arachin can be obtained in the form of a fine, white powder. Arachin can also be precipitated from a 10 per cent. sodium chloride solution by adding water until a slight cloudiness appears, and then saturating the liquid with carbon dioxide gas.

For the coagulation tests a fresh solution of arachin was prepared as follows: A fresh, filtered, 10 per cent. sodium chloride extract of the peanut meal was made 40 per cent. saturated with ammonium sulphate. The precipitated arachin was redissolved in salt solution, and reprecipitated by dilution with 10 volumes of water. From half a gram to a gram of the moist precipitate was dissolved in 20 c.c. of 10 per cent. sodium chloride solution.

Ten cubic centimeter portions of the arachin solution when slowly heated began to show cloudiness at 90° C., but no precipitate formed even when the solution was boiled. When the hot solution was slightly acidified with acetic acid a heavy precipitate formed.

For determining the specific rotation of arachin a 10 per cent. sodium chloride solution was used. The average of several closely agreeing polarimetric readings gave $[\alpha]D/20 = -39.5°$.

Precipitation Limits with Ammonium Sulphate.

Ten cubic centimetres of 10 per cent. sodium chloride solution containing 2 per cent. of arachin was treated with trichloracetic acid. The precipitate was filtered off, and the filtrate examined for nitrogen. No nitrogen could be detected. Measured quantities of a saturated solution of ammonium sulphate were then successively added to 10-c.c. portions of the solution. The precipitates were filtered off, and trichloracetic acid was added to the filtrates. The smallest quantity of ammonium sulphate which had to be added so that the filtrate would give no turbidity with trichloracetic acid, thus showing complete precipitation of the arachin, was found to be at 40 per cent. of saturation. Most of the arachin was precipitated at 30 to 32 per cent. of saturation.

Properties of Conarachin.

Besides the differences in their chemical composition as noted in previous publications, the two peanut proteins are distinguished by marked physical differences. Conarachin is much more soluble than arachin. It cannot be precipitated from its salt solution by dilution with water without the use of enormously large volumes. It also differs greatly from arachin in its coagulation temperature and precipitation limits with ammonium sulphate and in specific rotation.

Solutions of conarachin were prepared for the coagulation tests as follows: The arachin was first sparated from a fresh salt extract of the meal by precipitation with ammonium sulphate (40 per cent. of saturation), and the filtrate dialysed in parchment bags against running water for 20 days, toluene being used as a preservative. The clear dialysate was decanted, and the precipitated conarachin was washed with distilled water and dissolved in 10 per cent. sodium chloride solution (1 gm. moist precipitate per 40 c.c. of solvent).

When the conarachin solution was heated slowly the globulin flocculated at 80° C. On being heated to boiling the filtrate remained clear.

Specific rotation determinations made on 10 per cent. sodium chloride solutions of conarachin gave an average of $-42.7°$.

No precipitation occurred on addition of ammonium sulphate until 80 per cent. of saturation was reached. All the conarachin was precipitated at 80 to 85 per cent. of saturation.

To be continued.

SEVENTY YEARS AGO.

(From the Chemical News, Dec. 17, 1859.)

ON ISOMERIC ALKALOIDS.

While investigating the organic alkaloids produced by destructive distillation, I was struck by the almost entire coincidence of the formulæ of the bodies found from the most opposite sources. Thus, coal, bituminous shale, Dippel's oil (bone oil), and cinchonine, all appeared to yield alkaloids belonging to the same series. But although the composition of the same alkaloids from each source was identical, and even their boiling points agreed as well as could be expected, yet there were differences in the smell, power of forming crystalline salts, etc., which presented themselves during the course of these long investigations, and at times almost induced a belief that I was dealing with isomers instead of identical bodies. The greatest differences were found with the bases produced by destructive dis-

tillation of cinchonine. Here the odour of the alkaloids was so different to that of the same bodies extracted from other sources that I long oscillated between two opinions. However, the resemblances were too numerous to justify me in announcing the pyridine series, as obtained from cinchonine, to be a new class of alkaloids. In fact, the absence of absolutely distinct reactions rendered such a course impossible. I have, however, at length discovered a reaction with the chinoline series as obtained from cinchonine, which is so totally different from anything which can be obtained with the chinoline series from coal tar, that I am fully persuaded of their being essentially different.

Chinoline, or lepidine from cinchonine, was boiled with iodide of amyle for a few minutes, after which water was added, and the boiling continued for a short time. The product was a brown oily-looking fluid, suspended in the water. A little ammonia was now poured in, and the boiling continued for a short time longer, when the whole of the oil became converted into a magnificent blue colour of the utmost intensity. It dissolves readily in alcohol, and the diluted fluid dyes silk of a fast and most brilliant blue, having a slight shade of purple.

So strong is the attraction of silk for the dye that the bath becomes colourless, every trace of colour being taken up. It has but small tendency to unite with cotton, for if the latter, after being dyed blue, be boiled with silk, the cotton becomes colourless and the silk absorbs all the colour.

The coal tar bases of the same composition present nothing similar. They may, it is true, be made to yield superb colouring matters, but by totally different modes of procedure.

I *am at present endeavouring to ascertain* whether the pyridine series from cinchonine possess any features sufficiently distinct from the same series as extracted from coal, to justify the conclusion of their being a distinct class.

OPIUM GROWING IN JUGOSLAVIA.

According to *The Central European Observer* there is a considerable area in South Serbia and Macedonia devoted to opium growing and although the weather conditions last year were unfavourable, 69,000 kilograms were exported. The crop is mainly disposed of in Germany, Switzerland, Great Britain and U.S.A. for industrial and chemical purposes as a source of narcotic drugs.

GENERAL NOTES

CATERING FOR NEEDS OF OVERSEAS MARKETS.

WONDERFUL EXHIBITS AT ROYAL SHOW.

The Royal Show which opened at Manchester on Tuesday, July 8, is notable for one exhibit which by itself should go far to dispel the idea that the British manufacturer disregards the needs of overseas markets.

The exhibit is that of the Agricultural and General Engineers, who have had the courage and good sense to stage a show of machinery and implements which they are making for the specialised requirements of customers all over the world. The result is to show that the U.K. can supply the needs of every type of agriculturist from the great wheat farmer of Canada to the poor Indian peasant cultivator.

MACHINES FOR CANADA, INDIA, AFRICA, BRAZIL, ETC.

A powerful steam tractor, with water tanks, *coal bunkers and winding gear for* haulage purposes, is particularly designed for use in South Africa where heavy loads have to be carried over long distances through spruits and over other obstacles. Another implement is similar in general design to the Indian ryot's home-made plough—with the important difference that it can be converted into a plough, a disc-harrow, a cultivator or a seed-drill, and all without the aid of any such tool as a spanner, which would almost inevitably be lost at once.

Then there are coffee pulpers, designed for the smallest grower in the Belgian Congo and for the largest estate in Brazil; a special portable machine for decorticating the sisal grown in East African plantations; a "*huller*" *for rice and even a patent sheller for growers of monkey nuts*!

All these are products of what is in reality a new, post-war industry. Until recent years no one had catered so specifically for the needs of agriculturalists and planters all the world over.

INTER-IMPERIAL MARKETING ARRANGEMENT.

Up till this year for example there was never any serious production of tractors in England. At Manchester many different types are shown, some driven by petrol, and others by crude-oil engines. Of particular interest is the all-Empire character of two of the exhibits. It was announced some months ago that the completion of A.G.E.'s world-selling organisation in-

cluded an arrangement with the great Australian firm of McKay (Propty.) Ltd., of Melbourne, for the marketing of the "Sunshine" harvesters in South America. Two types of these harvesters are shown. The importance of this inter-imperial arrangement is that the Empire is now able to supply the whole range of the South American farmer's requirements which has up to the present been almost exclusively done by the U.S.A.

NINE FOREIGN LANGUAGES USED.

Another common complaint is that the British manufacturer does not appreciate the importance of foreign languages. It would be impossible for A.G.E. to operate their world organisation efficiently without using the language of the country concerned. *No less than nine different languages may be used in dealing with A.G.E.!*

FERTILISER MANUFACTURE IN ONTARIO.

The new fertiliser plant under construction by Canadian Industries, Ltd., at Hamilton, Ont., is expected to be in operation by August 1, and an extension of the equipment is likely to be undertaken next year. The initial plant is expected to cost between $2,000,000 and $3,000,000, but well over $1,000,000 are likely to be spent on developments connected with the undertaking. Among these will be the construction of a new dock in Hamilton Harbour, work on which is likely to be undertaken some time during the next few months. A large market is expected for the Company's product through the Niagara fruit-growing belt of Ontario, where farmers are at the present time utilising imported fertilisers.

The new fertiliser plant and dock on the waterfront at Hamilton will be important developments in association with the shipping activities at Hamilton Harbour. Final figures just published by the Hamilton Harbour Commission indicate that last year as many as 1,592 vessels with a total tonnage of 1,373,000 tons entered the port, the total gross tonnage handled being 1,064,000 tons. The freight carried included coal, sand, oil, package freight, sugar, flour, sulphur and wire iron and steel. From the various harbour docks, 67,687 tons of package freight were exported, and 10,950 tons of agricultural implements.

CANADIAN AMMONIUM SULPHATE PRODUCTION.

According to information compiled by the Dominion Bureau of Statistics at Ottawa, the production of ammonium sulphate in Canada during 1929 amounted to 34,141 tons valued at $1,293,953 as compared with 28,090 tons worth $1,108,744 in 1928. All of the ammonium sulphate made in Canada is produced as a by-product of the coke and artificial gas industries.

A large part of the Canadian production is exported to foreign countries for use as a fertilizer. In 1929 exports totalled 24,489 tons worth $909,510 as compared with 13,632 tons valued at $591,696 in 1928. The principal countries of destination with the quantities and values of Canadian export to each were as follows:—Japan, 10,095 tons worth $375,020; United States, 6,857 tons worth $220,734; Hong Kong, 2,155 tons at $93,783; Barbados, 1,909 tons at $81,460; China, 1,304 tons at $50,434; Other British West Indies, 822 tons at $33,871; British Guiana, 546 tons at $23,158; and Porto Rico, 302 tons at $13,025.

Some ammonium sulphate is imported into Canada. During 1929 about 1,723 tons worth $80,019 were brought into Canada; the bulk of this came from the United States. In 1928 the imports were 3,510 tons worth $174,899.

Seven factories in Canada made ammonium sulphate during 1929. The producing plants were located as follows:

Algoma Steel Corporation, Sault Ste. Marie, Ontario.

Steel Company of Canada, Limited, Hamilton, Ontario.

Hamilton By-Product Coke Ovens, Limited, 15 Main Street, Hamilton, Ontario.

Dominion Iron and Steel Co., Limited, Sydney, N.S.

Montreal Coke and Manufacturing Co., Montreal, P.Q.

Ottawa Gas Company, Ottawa, Ontario.

British Columbia Electric Power and Gas Co., Ltd., Vancouver, B.C.

LARGEST NITROGEN PLANT IN NORTH AMERICA.

The largest nitrogen fixation plant in the Western hemisphere is located at Hopewell, Virginia, on the James River, 80 miles from Hampton Roads. It is operated by the Atmospheric Nitrogen Corporation, and is now producing over 350 tons of fixed

nitrogen daily as sodium nitrate and anhydrous ammonia. This production is nearly twice that of all other U.S. plants combined. The chief distinction of the plant lies not in its size, however, but in efficient plant lay-out which is both compact and readily expandable perpendicular to main axis. The chemical reactions involved are mater ialized on the ground in straight line flow, with two parallel lines each one half mile in length, one for NH_3 synthesis, the other for production of sodium nitrate. A modi fied Haber-Bosch process working at 200 atmospheres is used with raw gas generated entirely in a battery of water gas sets operating on combination make. Ammonia oxidation in an interesting new development leads through other oxidation towers and soda obsorbers to the evaporators and centrifuges, from which large conveyors lead directly to huge storage facilities or to both rail and ocean-going water transportation. The works cost about $37,000,000.

POTASH FROM POLYHALITE.

A detailed study of the properties of Texas polythalite with the possible application of these in the industrial extraction of potash in view, has been conducted during the past two years by the Nonmetallic Minerals Experiment Station of the United States Bureau of Mines, Department of Commerce, at Rutgers University, New Brunswick, N.J.

Two processes have been developed one of which produces potassium sulphate and the other both potassium sulphate and a double salt containing magnesium and potassium sulphates. Preliminary cost estimates show that the average cost of producing 90 per cent potassium sulphate by either of these processes will be $16 per ton at the plant, and the cost of producing the double sulphate of potash-magnesia will be $8 per ton at the plant. If a reasonable freight rate to seaboard can be obtained, it is probable that potash from Texas poylhalite can successfully compete with the imported products.

Further investigations have geen made on the extraction of calcined and uncalcined polyhalite with saturated salt solutions, and the data thus far obtained show that it will probably be possible to develop an industrial process for the manufacture of muriate of potash from Texas polyhalite.

Results have also been obtained concerning the rate of decomposition of polyhalite by water at atmospheric temperatures using varying ratios of polyhalite to water. These data show that the use of finely ground polyhalite per se as a fertilizer is possible, the rate of decomposition being rapid enough to dissolve al of the potash in a few days assuming a temporate climate where a ratio of 6 ports of water to one of polyhalite is feasible.

COPPER DEPOSITS IN ARCTIC CANADA.

The Dominion Department of the Interior has just forwarded to the Acting High Commissioner for Canada in London a copy of a Report by Major L. T. Burwash, M.E., F.R.G.S., on the "*Coronation Gulf Copper Deposits.*"

Major Burwash was sent into the western Arctic by the Department in June, 1928, with instructions to investigate certain pro-lems relating to native life, navigation and transportation. While in the North, wireless instructions were received to conduct an examination of the mineralised areas of Coronation Gulf and Bathurst Inlet. The Report in question represents the results of the investigation conducted by him, and copies may be available shortly for distribution to learned societies and individual enquirers who may be interested. Application for copies should be made either to the Department of the Interior at Ottawa, or to the Secretary, Office of the High Commissioner for Canada, The Canadian Building, Trafalgar Square, London, S.W.1.

NEW GAS PLANT FOR VANCOUVER.

The British Columbia Electric Power and Gas Company, Ltd., a subsidiary of the British Columbia Power Corporation, Ltd., proposes to erect shortly, at a cost of $750,000, a new coal gas plant with an eventual daily capacity of 25,000,000 cubic feet. The first unit is expected to be completed by the autumn of 1931. The new gas plant is to be erected on the site on which the Company last year completed a large gas holder, and eventually there will be erected another holder and a purifying, scrubbing and ammonia extraction plant.

Work on the new gas plant is expected to begin in July and construction will take about 16 months. The plant will use British Columbia coal, and in purchasing equipment, preference is being given to British manufacturers.

OVERSEAS TRADE.

The Secretary of the Department of Overseas Trade announces that Sir William H. Clarke, K.C.S.I.,K.C.M.G., High Commander in Canada for His Majesty's Government in the United Kingdom, attended a meeting of the Overseas Trade Development Council on the 24th June, 1930, in order to discuss with the Council the development of United Kingdom trade with Canada, especially in relation to the recent Canadian Budget.

Sir William Clarke made an important tatement and the Secretary of the Department of Overseas Trade feels that it should eceive the utmost publicity in the interests f our trade with Canada.

In the first place Sir William Clark emhasised the importance of the Canadian narket not merely in relation to the present ut having regard also to the future develpment of the Dominion. He had come ack after a year and a half in Canada rofoundly impressed with the fundamental trength of her economic situation and the romise of her future. He invited the ouncil to consider her remarkable progress n the last 15 years. In 1913, for instance, er exports amounted only to £73 million, quivalent to about £110 million in current alues, whereas by 1929 they had risen to 273 million. Her imports in 1929 amounted to some £253 million: if imports had ot shown a conspicuous increase like exorts, it was owing to the remarkable increase of production in Canada herself. here had been, especially in recent years, reat development of her mineral resources, ut the special feature of her economic proress was the notable growth of her indusies. This might at first sight be thought factor not too promising for export trade the United Kingdom, but it was necessary to take into account the greatly increased purchasing capacity which had accomanied it and which had correspondingly nlarged Canada's demand for many indusrial products which she did not manufacture herself. As a result of all this progress e now stood fifth of all countries of the orld in aggregate external trade, coming ext after the United States, United Kingom, Germany and France, and was easily rst of the five in external trade as measured per head of population. Her achievement, indeed, was the more remarkable in iew of her as yet comparatively small poplation of some hundred millions. It was a tribute to the high degree of organisation and mechanisation alike in agriculture and industry. In this connection Sir William called attention to her immense resources for the production of hydro-electric power which were being so efficiently developed and which were affording power for her industries on probably the cheapest terms of any country in the world.

Taking all these factors into consideration he doubted if there was any country to-day which was more likely to show rapid economic progress in the immediate future. He wished, therefore, to emphasise once again the importaince of British business strengthening its position in a market already so valuable and with such promise of further advance.

At the present moment Canada took some two-thirds of her total imports from the United States and only one sixth or seventh from Great Britain. Sir William felt that the moment had come when there was a real chance that this disparity might be lessened if appropriate efforts were made by United Kingdom exporters. Increase in duties under the United States tariff was making trade more difficult for Canada with the United States, and she was looking naturally to Great Britain, which from early days had been the outstanding market for her staple products. Apart from this, so to speak, business motive, there could be no doubt about Canada's willingness to buy more from the Mother Country. It had been his privilege to travel widely thrughout the Dominion and he found everywhere a growing desire to buy from the United Kingdom goods not yet produced in Canada Budget were one expression of this desire. United Kingdom exporters on their side could best manifest their appreciation of the opportunities thus offered to them by using them to the full.

As regards the increased preferences themselves Sir William pointed out that they covered a very wide range of headings in the Tariff which he was not competent to discuss in detail, but which no doubt were being studied by the various industries concerned. The whole tariff scheme, be understood, had been drawn up after most detailed examination by the Canadian Tariff Board of the many questions involved. The double object in view had been to stimulate Canadian industry and to give every possible advantage to Great

Britain. He had had the privilege of some talks on the matter with Mr. Dunning, the Finance Minister, who greatly hoped that the many tariff concessions would result in increased imports from the United Kingdom and urged that every effort should be made to utilise them. There would appear to be special openings under the iron and steel schedules; for tableware of china and procelain; and for machinery of many kinds. He thought that this latter heading would be particularly worth of study by United Kingdom manufacturers in view of the wide range of mechanical development which was going on in Canada and the large amount of constructional work, including roadmaking, improvement of waterways, etc., which was being undertaken.

In conclusion Sir William Clark urged again that a very special effort should be made to increase United Kingdom trade with Canada. It would be a mistake to assume that the better results which were desired could be secured without effort. But the new tariff was an invitation to make a new effort, and he felt very sure that such an effort would be warmly welcomed in the Dominion. He urged that the first step should be for the different manufacturing industries of the country to study closely the new advantages offered them under the Canadian Tariff, and then that they should spare no trouble and expense to explore how best they could handle their trade and push the sale of their goods in the Dominion.

Proceedings and Notices of Societies

THE GEOLOGICAL SOCIETY.

June 25th, 1930.

Prof. E. J. Garwool, M.A., Sc.D., F.R.S., Presilent in tre Crair.

William Lyall, M.Inst.M,E., 19 Victoria Road, Darlington (County Durham), and Loris Shano Russell, M.A., Ph.D., Graduate College, Princeton, New Jersey (U.S.A.), were proposed as Fellows of the Society.

A lecture on the *Tertiary Igneous Complex of Ardnamurchan* was delivered by James Ernest Richer, M.C., B.A., F.R.S.E., F.G.S.

The Lecturer said that Ardnamurchan is the last of the well-known igneous complexes of Western Scotland to be studied in detail by the Geological Survey, and illustrates in a comparatively simple manner many of the remarkable features of Tertiary igneous activity in Britain. The map ping was carried out by Prof. E. B. Bailey, Mr. Simpson, and the Lecturer, and Dr. Herbert H. Thomas had been responsible for the petrology.

The district measures some 9 miles from east to west and 5 miles from north to south. It is chiefly noteworthy on account of its intrusive rocks, and only small outliers of the widespread Tertiary plateau basalt lavas are preserved. The types of intrusion include volcanic vents piercing the basalt lavas, and largely filled with acid and trachytic fragmental materials; minor in trusions, incuding cone-sheets, chiefly quartz-dolerite, occurring mainly as ring-dykes. The above, excepting the dykes, are arranged in concentric series around three different centres, marking three foci of igneous activity which functioned successively.

Around Centre I, situated on the east, there are extensive volcanic vents, a few major intrusions, and a set of massive cone-sheets. In relation to Centre 2, on the west, periods of con-sheet and ring-dyke intrusion alternated, and there is only one small elongate vent. Country-rocks were first domed around this centre and then copiously injected by cone-sheet, including many of composite habit ,with acid centres. These cone-sheets form an outer set around the succeeding ring-dykes. The intrusion of the ring-dykes was interrupted by a second, inner, suits of cone-sheets. Although only a single vent is developed, explosive brecciation of the walls of ring-dykes, or of entire ring-dykes themselves, is a recurring feature. The complex of Centre 3, situated midway between the two earlier centres, has obliterated large portions of those of earlier date. It consists of ring-dykes, with only a few cone-sheets cutting the outermost and earliest ring-dyke. The ring-dykes are, on the whole, successively younger as the centre is approached, and the more centrally situated include rock-types of rare occurrence in the British Tertiary province — biotite-bearing gabbros, tonalite, and quartz-monzonite. No vents are met with, and brecciation of the walls of ring-dykes is rarely seen. It is suggested that the three complexes are successively more deep-seated, due, presumably, to the growth of an overlying volcanic pile. The regular ring-patterns marked by the intrusions are, however, of

more especial interest. The constitute evidence of the formation of annular or arcuate fissures that are considered here, as in Mull, to have resulted from localised stresses set up in the roof of an underlying magma-reservoir.

North-west dykes are numerous, and were intruded at various times during the period of localised activity, as well as after its close. The more westerly belong, in part, at least, to the great Mull swarm.

Mr. J. B. Richey exhibited and explained, on his own behalf and on that of Mr. G. Torkington, a Geological Model of the Mourne Mountains (Ireland).

The next Meeting of the Society will be held on Wednesday, November 5, 1930, at 5.30 p.m.

ROYAL INSTITUTION.

His Royal Highness the Duke of York was elected an Honorary Member of the Royal Institution at the General Meeting held July 7, Sir Robert Robertson, Treasurer and Vice-President, in the Chair, and Miss Lilian Varley was elected a member.

GOVERNMENT AND PRICES.

The Federation of British Industries has appointed a committee which will furnish to the Government views upon the general principles of price maintenance. Its memthe Federation; Mr. S. E. Cash, its solicitor; and Mr. H. L. Kenward, sales manager of the Dunlop Rubber Co. Ltd. The latter has prepared evidence, more particularly applicable to the tyre industry, which has been forwarded through the India Rubber Manufacturers' Association to the Board of Trade.

CARBIDE OF CALCIUM FOR SOUTH AFRICA.

His Majesty's Senior Trade Commissioner in South Africa reports that the South African Railways and Harbours Administration are calling for tenders (Tender No. 1724) to be presented in Johannesburg not later than 1 p.m. on the 25th August, 1930, for the supply and delivery of approximately 231,500 lbs. of carbide of calcium.

Firms desirous of tendering can obtain further particulars of this call from the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. References B.X.6648 should be quoted.

CORRESPONDENCE.

THE RECOVERY OF INDIUM.

To the Editor of the Chemical News,

Sir,

I was interested in the article "Indium: Recovery by Electrodeposition" by L. R. Westbrook in your issue of July 11th, particularly as some time ago I communicated to a German journal some results I had obtained in connection with the recovery of indium from the black sludge left after generating H_2S from commercial sulphide and sulphuric acid (Indium, sein Vorkommen in Handelseisensulfid und dessen Auszüge, *Zeitschrift fur angewandte Chemie*, 1928, xli, 79). It was estimated that the commercial iron sulphide contained about 0.005 per cent of indium.

According to F. W. Clarke and H. S. Washington (*Proc. Nat. Acad. Sci.*, 1922, viii, 108) indium is widely distributed although never in any great quantity. They estimated that the lithosphere contains about 0.00000000x per cent of indium. Methods have been given for its extraction from zinc blendes and flue dust depending on its remaining undissolved whilst free zinc is present and now there comes Mr. Westbrook's electrolytic method.

The indium in the residues from making hydrogen sulphide was extracted by dissolving the ignited sludge in *aqua regia*, precipitating the heavy metals with hydrogen sulphide and, after filtering and boiling, precipitating the indium and iron with ammonia. The precipitated hydroxides were re-dissolved in hydrochloric acid, excess of ommonium acetate was added and the indium separated as sulphide. About 0.5 gr. of the element, m.p. about 154°C, was obtained in this manner from about 150 lbs. of commercial iron sulphide.

I am, yours etc., Gerald Druce, M.Sc. (Lond.), R.Nat. Dr. (Prague), F.I.C.

H.M. STATIONERY OFFICE.

Recent Publications of Statistical Interest.

AGRICULTURE :—

Agricultural Statistics, 1929. Vol. LXIV. Part I. Report on the Acreage and Production of Crops and Number of Live Stock in England and Wales with Summaries for Great Britain and Ireland. Price 1s. 3d. (1s. 5d.); 5 ozs.

Eighteenth Report of the Department of *Agriculture for Scotland for the year ended* 31st December, 1929. Cmd. 3516. Price 1s. 6d. (1s. 8d.); 6 ozs.

COMMERCE AND INDUSTRY :—

Accounts relating to Trade and Navigation of the United Kingdom, April, 1930. H.C.52-III. Price 3s. 6d. (3s. 9d.); 12 ozs.

Accounts relating to the Trade and Commerce of certain Foreign Countries and British Countries overseas. December, 1929. Price 5s. 6d. (5s. 8d.); 8 ozs.

EDUCATION :—

Education (Scotland): Statistics in respect of Education Areas for the year 1928-29. Price 4d. (5d.); 2 ozs.

Report of the Committee of the Privy Council on Education in Scotland for the year 1929-30, with summary statistics for Scotland for the year 1928-1929. Cmd. 3565. Price 1s. (1s. 2d.); 5 ozs.
School year 1928-29. Board of Education. Price 6d.; 2 ozs.

Statistics for the Area of each Local Education Authority of (1) the distribution of full-time pupils in the Schools and (2) the school life and leaving-age of full-time pupils who left during the school year.

EMPIRE MARKETING BOARD REPORTS :—

Cocoa. World Production and Trade. E.M.B. 27. May, 1930. Price 1s. (1s. 3d.); 11 ozs.

FISHERY INVESTIGATIONS :—

Salmon Fisheries, 1929. No. V. Sea Trout of the River Tweed. Fishery Board for Scotland. Price 3s. 6d. (3s. 8d.); 7 ozs.

PUBLIC ACCOUNTS :—

Civil Estimates, including Pensions. Education. Insurance and other Grants and Exchequer Contributions to Local Revenues for the year ending 31st March, 1931. H.C.88. Price 14s. (14s. 9d.); 2 lbs. 14 ozs.

Queen Anne's Bounty. Annual Report and Accounts of the Governors for the year ended 31st December 1929. Price 1s. (1s. 1d.); 3 ozs.

Racecourse Betting Control Board: First Annual Report and Accounts, 1929. H.C.116. Price 2s. 6d. (2s. 8d.); 8 ozs.

REGISTRAR-GENERAL :—

England and Wales :—
Births and Deaths. Weekly Return. Price 6d. (7d.); 2 ozs. *Annual Subscription*, 28s., *post free.*
Births, Deaths and Marriages, and cases of certain specified Infectious Diseases. Quarterly Return. Price 9d. (10d.); 2 ozs. (*Annual Subscription, 3s. 6d., post free.*)
Scotland :—
Births, Deaths and Marriages in the Principal Towns of Scotland. Weekly Return. Price 2d. (3d.); 1 oz.
Births, Deaths and Marriages in Sixteen of the Principal Towns of Scotland. Monthly Return. Price 3d. (4d.).
Births, Deaths and Marriages in Divisions, Counties and Districts of Scotland. Quarterly Return. Price 6d. (7d.); 1 oz.

SHIPPING :—

Registry of Ships. Board of Trade. April, 1930. Price 2s. 6d. (2s. 7d.); 2 ozs.
Transport :—
Railway Statistics—Great Britain. Ministry of Transport. No. 123. Price 3s. 6d. (3s. 8d.); 6 ozs.
(A) Particulars of Traffic Carried by Passenger and Freight Trains, Statistics of Operation, etc., for the month of February, 1930.
(B) Marshalling Yard Statistics for the month of February, 1930.

MISCELLANEOUS :—

Report including Returns from Universities and University Colleges in receipt of Treasury Grant, Academic Year 1928-29. University Grants Committee. Price 3s. 6d. (3s. 9d.); 9 ozs.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

19,681.—Clarke, L. M. and Spittle, H. M. and Imperial Chemical Industries, Ltd., Manufacture of sodium sulphide. June 28.

19,591.—Deterding, Sir H. W. A. Treating gasoline. June 27.

19,210.—(Du Pont de Nemours and Co., E. I.).—Methods of producing benzanthrone. June 24.

19,123.—(Dynamite Akt.—Ges-M vorm. Nobel & Co., A.).—Manufacture of monoethanolamine dinitrate. June 23.

19,122.—(I. G. Farbenindustrie Akt-Ges.). —Desulphurization or organic substances. June 23.

Specifications Published.

330,916.—(I. G. Farbenindustrie Akt-Ges,). —Manufacture of aryl-acetic acids and substitution products thereof.

330,919.—Natta, G.—Manufacture of methyl alcohol.

308,599.—Bayerische Stickstff-Werke Akt.-Ges.—Production of phosphoric acid and hydrogen.

309,602.—Soc. L'Air Liquide, Soc. Anon. Pour L'Etude et L'Exploitation Des Procédés G. Claude.—Production of hydrogen perozide.

Printed copies of the full Published Specifications may be obtained from the Patent office, 25, Southampton Buildings, London, W.C.2., at the uniform price of 1/- each.

Abstract Published.

328,963.—Phosphoric acid esters. (I. G. Farbenindustrie Akt-Ges.; Frankfort-on-Main, Germany.).

One molecular proportion of phosphorus oxychloride is caused to react with from one to two molecular proportions of a primary aliphatic alcohol, or phenol, in the manner described in the parent Specification, and the acid-ester obtained is caused to react with a different aliphatic alcohol from that initially employed, or with a phenol when an aliphatic alcohol was used in the first stage, so as to produce a neutral mixed ester. In an example, 2 molecular proportions of *iso*-amyl alcohol are mixed while cooling with 1 molecular proportion of phosphorus oxychloride during the course of an hour. The reaction mixture is then heated under a reduced pressure of 50 mms. of mercury at a temperature of 50° C. for about 80 minutes. The whole is cooled, an excess of butyl alcohol is added and the reaction continued for 30 minutes at 40° C. *n*-butyl di-*iso*-amyl phosphate is obtained. The preparation of the following esters is also described :—di-ethyl *iso*-amyl phosphate, dibutyl phenyl phosphate. Specifications 181,835 and 330,228 are referred to.

Printed copies of the full published specifications may be obtained from the Paten Office, 25, Southampton Buildings, Londor W.C.2., at the uniform price of 1/- each.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by *permission of the Controller of His* Majesty's Stationery Office.

ZEROSEL.

512,888.—A chemical substance used in water softening.—Lime-Free Water & General Service, Ltd., 20, John Street, Adelphi, London, W.C.2. July 2nd.

ZORIC.

512,819.—Carbon tetrachloride for use in manufactures.—British - American Laundry Machinery Co., Ltd., 4 to 6, Underhill Street, London, N.W.1. July 2nd.

RAYFERT.

501,730.—Chemical substances used for agricultural, horticultural, veterinary and sanitary purposes :—Joseph Hodgson, trading as Raydus Products, Co., Old Castle Buildings, 26, Preesons Row, Liverpool. July 2nd.

KILSECTOL.

512,998.—Chemical substances used for agri cultural, horticultural, veterinary and sanitary purposes :—W. & F. Walker, Ltd., Colonial House, Water Street, Liverpool. July 2nd. (By Consent).

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NOTICE TO AUTHORS & CORRESPONDENTS

Contributions for publication either as original articles or in the correspondence columns are welcomed by the Editor of *The Chemical News.*

They must be accompanied by the contributors' full names and addresses, not necessarily for publication, but as an indication of good faith. If a reply is needed or if it is desired that a manuscript which is not accepted for publication be returned, a stamped addressed envelope should be enclosed.

No notice can be taken of anonymous letters.

ELECTROLYTIC CHLORINE AND CAUSTIC SODA INDUSTRY IN JAPAN.

By TSUTOMU SHOJI.

The trial manufacture of electrolytic chlorine and caustic soda was at first carried out about thirty years ago, but it had not been economically established for a long time. During the last World-war, the demand of caustic soda was rapidly increased, but its smooth import from the abroad was hardly realized, and therefore its home production was again enterprised.

Thus twenty or more plants were erected, one half of which, however, has been fallen off in the competition of the market after the war, and at present there are 12 plants in total, producing about 50,000 tons of chloride of lime and 25,000 tons of caustic soda annually.

The Total capital invested in this industry amounts to about Y13,000,000, and the total productive capacities of chlorine and caustic soda exceed 25,000 tons and 30,000 tons respectively, and the consumption of electric power will attain to about 12,000 K.W. by operating with full capacity.

In Japan, the demand of caustic soda is fairly good, and about 80,000 tons are consumed per year, but the demand of chlorine, which is mainly used for the manufacture of chloride of lime, is limited, and so the further expansion if this industry is now hardly desired.

CHLORIDE OF LIME (Unit in 1000 kg).

	Production	Export	Consumption
1924	36,975	2,641	34,334
1925	38,062	2,562	35,500
1926	32,954	2,639	30,315
1927	38,656	2,608	36,048
1928	42,414	3,105	39,309
1929	55,085	3,134	51,951

The greater parts of the chloride of lime, more than 70 per cent of the total output, are consumed in pulp and paper industries, the remainder being used for the bleaching of cotton yarn and fabric or for the sterilization of water.

One part of chlorine is also used for the manufacture of liquid chlorine, hydrochloric acid, high-grade bleaching powder (about 70 per cent available chlorine), sulphur chloride, chlorbenzol, mono-chloracetic acid and others, but excepting hydrochloric acid their production is not so much to mention here.

The production of hydrochloric acid by the combustion of chlorine and hydrogen is estimated to about 5,000 tons per year, and there are six producers in total.

Chlorine and Caustic Soda Makers in Japan.

Name.	Locality.	Established or started in	Type of cells
Asahi Denka-Kogia K.K.	Ogu, near Tokio	1917	Siemens-Bilitter
Dainippon Jinzo-Hirio K.K.	Oji, near Tokio	1917	Townsend
Hodogaya Soda K.K.	Hodogaya, near Yokohama	1915	Nakano
Hokkai Soda K.K.	Fushiki	1919	Nelson
Mitsui Kozan K.K.	Omuda	1918	Allen-Moore
Nankai Sarashiko K.K.	Wakayama	1918	Nelson
,, ,,	Kochi	1926	Nelson
Nippon Soda K.K.	Nihongi, Niigata Pref.	1920	Nakano
Osaka Soda K.K.	Kokura	1916	Mercury
Rasato Rinko K.K.	Osaka	1918	Yoshimura
Showa Soda K.K.	Nagoya	1929	Allen-Moore
Tokai Soda K.K.	Nagoya	1917	Allen-Moore

N.B.—Nakano and Yoshimura types are horizontal diaphragm cells invented in Japan.

Caustic Soda (Unit in 1000 kg)).

	Production: electrolysis	Production: causticising soda ash	Import	Consumption
1924	21,416		15,668	37,015
1925	25,216		22,331	47,330
1926	14,560	8,919	36,498	59,985
1927	17,919	7,095	41,275	66,235
1928	20,467	7,655	61,612	89,701
1929	26,607	6,920	42,727	76,242

The total demand of caustic soda is about 80,000 tons at present, about 60 per cent of which being imported from the abroad, 30 per cent and 10 per cent produced in the country by electrolysis and causticising imported soda ash respectively.

Recently the consumption of caustic soda in Japan rapidly increased on account of the development of the viscose silk industry, and this industry and soap industry absorb more than 60 per cent of the total demand in the country, the remainders being used for textile, dyeing, paper, petroleum and other chemical industries.

By-product hydrogen is mainly used for the hardening of oils and Japan produces at present about 20,000 tons of hardened oil per year. One part of hydrogen is also used for the manufacture of hydrochloric acid as mentioned above.

Since in Japan common salt is manufactured by evaporating concentrated brine gained from sea-water at salt works with fuels, it costs too high to use it for soda industries, and therefore our soda makers import it from Tsingtao and Kwantung, where salt is made by solar evaporation. A few years ago, however, they had to import it from Spain and even Egypt for a while, for after Japan restituted Tsintao to China by Washington treaty, the detailed agreements with regard to the export of salt there had not been decided and its export was stopped.

Graphite anodes used for the electrolysis of brine were entirely imported from America up to a few years ago, but to-day those made in our country and in Germany are also used.

Lime of good quality and cheap electric power are rich in Japan and therefore our soda manufacturers are in very favourable conditions in these respects.

NOTE ON SOME ATTEMPTS TO CONDENSE PHENYLTHIOCARBIMIDE WITH THE HYDRIDES OF ARSENIC AND PHOSPHORUS.

By R. F. Hunter, D.Sc, Ph.D., D.I.C. A.R.C.S.

In view of the generality of the synthesis of aminobenzthiazoles from arylthiocarbamides by treatment with bromine in chloroform (Hugershoff, *Ber*, 1903, *36*, 3121; Hunter, *J. Chem. Soc.*, 1925, *127*, 2023, 2270; 1926, 1385, and later), it appeared probable that an extension of this reaction to *phenylthio-arsenocarbamide* (I) and to *phenylthio-phosphenocarbamide* (II) would provide easy access to the hitherto unknown 1-*arseno-* and 1-*phosphino-benzthiazoles* (III and IV respectively).

(I) $PhNH.CS.AsH_2$

S

(III) $C_6H_4 < \; > C.AsH_2$

N

$$Ph.NH.CS.PH_2 \quad (II)$$

$$\downarrow\uparrow$$

$$S$$

$$C_6H_4< \quad >C.PH_2 \quad (IV)$$

$$N$$

The simplest means of preparation of the required arseno and phosphinocarbamides appeared to be by condensing phenylthiocarbamide with the requisite arsenic and phosphorus trihydrides:

$Ph.NCS+AsH_3=Ph.NH.CS.NsH_2$ (i)

$Ph.NCS+PH_3=Ph.NH.CS.PH_2$ (ii)

unfortunately, however, all attempts to condense phenylthiocarbimide with arsine and phosphine, under conditions in which the mustard oil is rapidly converted into the thiocarbamide by ammonia, proved unsuccessful; the unchanged thiocarbimide being recovered in all cases.

EXPERIMENTAL.

(A) *Phenylthiocarbimide and Arsine.*—A solution of pure phenylthiocarbimide (2 cc.) in absolute alcohol (15 cc.) was warmed to about 40° C. and saturated as completely as possible with arsine, generated by the action of a solution of arsenious oxide in hydrochloric acid on nascent hydrogen obtained from zinc and hydrochloric acid. A certain amount of black arsenic was deposited; the mixture was diluted with more alcohol, filtered from a small residue of amorphous arsenic, and the solution was concentrated on a steam bath, when the original phenylthiocarbimide was recovered unchanged.

It appeared possible that the failure of this experiment might be due to the low solubility of arsine in alcohol. A solution of phenylthiocarbimide (2 cc.) in turpentine (10 cc.) was therefore treated with arsine diluted with hydrogen, at 100°; no external heat was developed. The phenylthiocarbimide was finally recovered unchanged as in the previous case.

(B) *Phenylthiocarbimide and Phosphine.*—The experiments with phosphine were similar to those carried out with arsine; phosphorous acid being used as the source of phosphorus trihydride. The failure of the first experiments was attributed to the insufficient saturation of the alcoholic solution of the thiocarbimide with phosphine, and in later experiments, the thiocarbimide was treated with a considerable excess of the trihydride. These experiments proved, however, to be as unfruitful as those with the arsenic hydride; phenylthiocarbimide being recovered unchanged in all cases.

Brighton Technical College,
Sussex.

THE PROGRESS OF NICKEL DEPOSITION IN RECENT YEARS.

By

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(*Continued from page 38.*)

THE IMPROVEMENT IN THE QUALITY OF NICKEL DEPOSITS FOR PROTECTIVE PURPOSES.

The effect of the improvements in control of acidity, the restriction of the composition of the solution to deliberately added constituents of definite value, and the reduction in the amounts of impurity likely to enter through the salts and anodes upon the quality of the nickel deposit, may now be considered.

(1) *Porosity.*

In 1906 Bancroft[20] suggested that the chief cause of the rapid rusting frequently observed in nickel deposits on steel was due to the large amount of iron they contained as a result of the high percentage of iron (6-10 per cent.) in the anodes then used. In 1916 Watts and Deverter[21] showed that the rusting that occurred on steel articles that had been nickel-plated was due to the plating being perforated by small holes or pores so that direct attack of the underlying steel was possible. They also showed that by increasing the thickness of the deposit the number of holes or pores was decreased (See Fig. 4, i and ii). In 1924 by means of the salt spray test Baker[22] confirmed the results of these investigations. He further found that porosity was still further decreased by forming deposits composed of three layers, first nickel, then copper, and finally nickel (See Fig. 4, iii).

(*i*) *Nickel deposit* 0.0005 *in. thick; showing pore.*

[20] W. D. Bancroft. Discussion on Adams' paper, *loc. cit.*

[21] O. P. Watts and P. L. Deverter. "Protection of Iron by Electroplating." *Trans. Amer. Electrochem. Soc.*, 1916, xxx, pp. 145-155.

[22] E. M. Baker. "The Rust Resistance of Nickel Plated Steel." *J. Soc. Automotive Engineers*, 1924, xiv, pp. 127-133.

(*ii*) *Nickel deposit* 0.001 *in. thick; pore eliminated.*

NICKEL COPPER NICKEL

(*iii*) *Composite deposit* 0.001 *in. thick; pore eliminated.*

Fig. 4. Showing how thick and composite deposits eliminate porosity.

Thomas and Blum[23] made more extensive investigations, which included a study of the influence of various methods of preparation of the steel articles prior to deposition and the effect of the composition of the bath, as well as the influence of the thickness of the deposit. A variety of corrosion tests were used, *viz.* : (*a*) the salt spray test, (*b*) intermittent immersion in salt solution, (*c*) the ferricyanide test, (*d*) atmospheric exposure. The results of these tests showed that the degree of porosity of the deposits is chiefly determined by their thickness. The results of the ferricyanide tests were found to agree more closely with the results of atmospheric exposure than did those of the other tests. Baker's conclusions that an intermediate layer of copper secured superior results were also confirmed, and similar improvement was obtained by forming an initial layer of copper from a copper cyanide solution prior to nickel deposition. This latter result was in agreement with the published conclusions of Schlotter[24].

The results of these investigations upon porosity encouraged certain users of nickel-plated steel articles to specify a minimum thickness of nickel of 0.001 in., and also encouraged the production of composite deposits of nickel and copper.

(2) *Pitting.*

This defect, which has sometimes been confused with porosity, consists in the appearance of small crater-like depressions over the surface of the deposit. These depressions usually penetrate nearly, if not quite through, the deposit, so that they cannot always be removed by buffing. It was early noted that these depressions were caused by the adhesion of gas bubbles to the surface of the cathode during deposition. Increase in thickness of the deposit was not always a remedy, the pits frequently becoming enlarged during the progress of deposition (See Fig. 5 *a*.) In 1916 Hogaboom[25] referred to this defect as being one of the outstanding problems for platers to solve, and although the more accurate control of *p*H and the use of purer materials for the anodes and solutions has been found to mitigate the trouble, they have not eliminated it entirely.

In 1924 Madsen[26] patented the addition of a small proportion of hydrogen peroxide to the solution, which he claimed to be an effective cure for pitting and the beneficial effect of this oxidising agent was subsequently confirmed. The manner in which it acts has not been definitely established, although Madsen[27] has suggested that it functions by oxidising organic matter and ferrous salts, which he claimed would otherwise stimulate the formation of, and increase the adhesion of the bubbles which give rise to pitting. However, certain drawbacks to the use of this material exist. Haring[28], for instance, found that the throwing power of solutions containing hydrogen peroxide is markedly reduced as a result of its presence, and it has also been found that the stress in the deposit is increased.[29]

Another remedy for pitting described by

[23] C. T. Thomas and W. Blum. "The Protective Value of Nickel Plating." *Trans. Amer. Electrochem. Soc.*, 1925, XLVIII, pp. 69-87 and 1927, LII, pp. 271-283.

[24] M. Schlotter. "The Estimation of Porosity. The Rust Resistance of Electrodeposited Nickel." *Brass World*, 1925, XXI, pp. 378-375

[25] G. B. Hogaboom. "Some Unsolved Problems of the Electroplater." *loc. cit.*

[26] *Loc. cit.*

[27] C. P. Madsen. "Mechanically Perfect Electrolytic Nickel." *Trans. Amer. Electrochem. Soc.*, 1924, XLV, pp. 249-256.

[28] *Loc. cit.*

[29] Macnaughtan. Discussion on Ollard's paper. *Metal Industry* (London), 1926, XXIX, p. 585. See :— E. A. Ollard. "Nickel Depositing Solutions." *Metal Industry* (London), 1926, XXIX, p. 581.

Dobbs,[30] and embodied in a certain type of plating plant, consists in the use of sufficiently violent air agitation of the solution to cause speedy removal of gas bubbles.

condition of the solution, but also as a result of imperfections in the basis metal. It has been found that an intermediate coating of copper of suitable thickness, such as

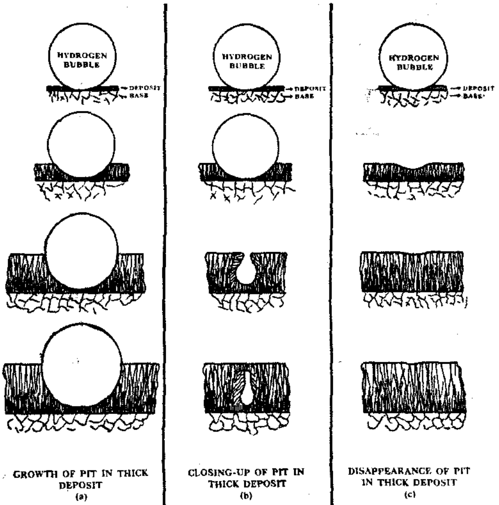


Fig. 5.—Diagrammatic illustrations of three common types of pitting which may occur in the production of thick deposits of nickel. According to the time of adhesion of the bubble, the pit may become progressively larger (a), *the deposit may grow over the pit, leaving a closed cavity* (b), *or the pit may disappear altoge ther* (c).

In view of the general obscurity of the conditions that cause pitting at one time and not at another, and the uncertain manner in which the various remedies function, a general investigation into the causes and prevention of the defect has been undertaken.[31] In the first stage of this work it has been shown that pitting may arise, not only as a result of a defective

[30] E. J. Dobbs. " The Commercial Deposition of Nickel." *J. Electroplaters' and Depositors' Tech. Soc.*, Nov., 1926, i-ii, pp. 557-559.

[31] D. J. Nacnaughton and A. W. Hathersall. " The Causes and Prevention of Pitting in Electrodeposited Nickel." *Trans. Faraday Soc.*, 1928, xxiv, pp. 497-509.

had already been found effective in reducing the porosity of deposits, serves also to decrease pitting due to defects on a steel surface. By the use of suitably prepared coppered surfaces it is thus possible to restrict the study of pitting to the type that arises solely from a defective condition of the solution.

(8) *Roughness.*

It was early found that roughness would develop on the surface of the deposit, if, instead of allowing slimes from the anodes and precipitated insoluble matter from the solution to settle out quietly, they were stirred up so as to be distributed through the solution. For this reason non-agitated baths were used until quite recently. Also, as temperatures above that of the atmosphere were liable to set up convection cur-

rents in the solution and so disturb the sludge, the advantages of the increased rates of deposition they made possible were foregone, owing to the tendency of such conditions to yield rough deposits. It was also recognised that certain soluble impurities, such as copper, were liable to cause roughness.

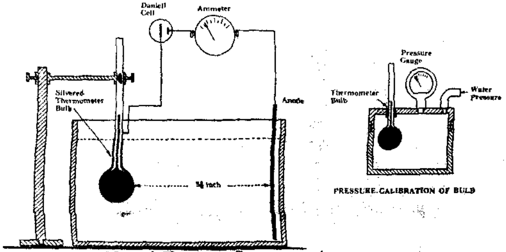
Nickel Deposits. Nickel Deposits.

Fig. 6.—Section through nickel deposits showing the influence of anode slimes in producing roughness.
Left : Uncontaminated bath.
Right : Bath contaminated with anode slimes.

With improvement in the quality of the anodes and salts used, the amount of insoluble residue in the bath has been decreased, but it is still sufficient to cause roughness if the solution is heated or agitated, unless steps are taken for its continuous removal by filtration. This has become increasingly adopted. In cases, however, where it is difficult to apply continuous filtration, the liability of the defect to occur has been considerably reduced by enclosing the anodes in a calico bag, so as to retain any solid particles which may become detached.

(4) *Peeling or Stripping.*

The tendency of nickel deposits to strip spontaneously from the cathode frequently caused serious trouble in the early days of nickel-plating. It was recognised that to counteract this tendency, it was essential to take greater care in cleaning prior to plating than in the case of copper or silver. It was also found that the tendency to strip was more pronounced when the temperature of the solution was low, as it frequently was in the winter months. The phenomenon excited scientific interest. In 1877 Mills[32] deposited nickel around the bulb of a thermometer, and found that a marked contractile strain was produced (See Fig. 7). In 1903 Johnson[33] referred to the serious distortion of steel cathodes that could be caused by the stress in the deposit. In 1909 Stoney[34] made some quantitative tests of the value of the stress by depositing nickel on one side



MILLS' ELECTRO-STRICTION APPARATUS.

Fig. 7.—In this early method for determining the stress in electrodeposited metals, the metal was deposited on the silvered thermometer bulb shown in the diagram on the left. The stress in the deposit caused compression of the glass bulb with a consequent rise in the level of the mercury in the capillary tube. The actual pressure associated with a definite rise in level was determined in the calibration apparatus shown in the diagram on the right.

[32] E. J. Mills. "Electrostriction." *Proc. Roy. Soc.*, 1877, XXVI, pp. 504-512.

[33] W. McA. Johnson. "Notes on the Electrodeposition of Nickel." *Trans. Amer. Electrochem. Soc.*, 1903, III, pp. 255-259.

[34] G. C. Stoney. "Tension in Metallic Films Deposited by Electrolysis." *Proc. Roy. Soc.*, 1909, LXXXII, pp. 172-175.

only of steel strips, and calculating from the degree of bending produced the force of tension in the deposit. In deposits from a nickel ammonium sulphate solution, he found that the tension in the deposit might amount to as much as 18 tons per square inch. He found the stress could be roughly halved by raising the temperature from 15° C. to 85° C. From 1918 onwards considerable attention has been devoted to the conditions influencing stress in nickel deposits by Kohlschütter[35] and his associates. They found that in a variety of solutions the stress was increased (a) when the current density was increased, (b) when the temperature was decreased, (c) when the hydrogen ion concentration was increased up to a certain point, or (d) when foreign matter, such as iron, was present in the deposit.

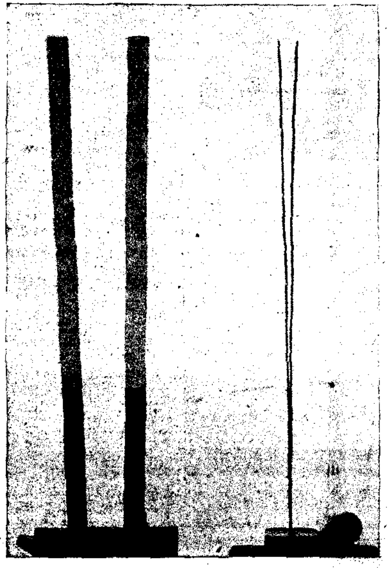


Fig. 8. A method of determining stress by measurement of the degree of bending produced in two steel strips. Each is coated with deposited nickel on one side only.

[35] V. Kohlschütter. "Relation between Polarisation and Structure in the Electrodeposition of Metals." *Trans. Amer. Electrochem. Soc.*, 1924, XLV, pp. 229-240.
E. A. Vuilleumier. "Application of the Contractometer to the Study of Nickel Deposition." *Trans. Amer. Electrochem. Soc.*, 1922, XLII, pp. 99-107.

* For full details see D. J. Macnaughtan and A. W. Hothersall. *Loc. cit.*

Under practical conditions it has proved possible to decrease the stress by the use of increased temperature, but this has been partly offset by the use of increased current density. Increased purity of the anodes, and more careful control of the acidity, have operated to prevent uncertain fluctuations in its value, but the most important development that has tended to decrease stripping has been the improvement in the methods of preparation of the articles prior to deposition, this securing a higher average degree of adhesion of the deposit.

(5) *Adhesion.*

The essential feature of the preparatory processes required to secure satisfactory adhesion of the deposit consists in the removal of any foreign matter which, if left on the surface of the article, would prevent intimate intermetallic contact between the deposit and the surface of the article. All traces of grease with associated dirt, and adhering oxide films must be removed.

For the removal of greasy matter the method originally favoured consisted in the immersion of the article for some time in a hot—usually boiling—solution of caustic potash or caustic soda, followed by a water rinse and then a scour with an abradent such as pumice. The alkaline solution was so strong as to be highly corrosive. It had little effect on mineral grease, whereas on vegetable and animal greases it acted chiefly by chemical attack tending to convert them into sticky films of partially saponified matter. Thus in use it grew progressively weaker and diminished in reliability.

It was found later that if certain alkaline salts, such as sodium carbonate or sodium phosphate, were added, more regular action could be obtained. These salts buffered the solution by providing a reserve of alkalinity which counteracted the tendency for the pH to fall as a result of chemical interaction with greasy matter.

Further improvements were secured by the addition of suitable soaps which, by providing colloidal matter, increased the emulsifying power of the solution[36]. During cleaning the colloidal particles which are in active movement tend to facilitate the breaking up of grease films into small droplets and, by further forming a film over them, tend to prevent their re-coalescence. The rate of emulsification is further increased by raised temperature, by the presence of finely divided suspended matter[37] and by agitation. If the agitation is provided directly at the surface of the articles by discharge of hydrogen gas produced by making the articles cathodic in the cleaning solution, extremely efficient cleaning is obtained.

For the removal of oxide films the usual method has been the use of an appropriate acid dip. In the case of steel articles this has commonly been 10 per cent. sulphuric, and occasionally 10 per cent. hydrochloric acid. The advantages of replacing acid pickling have more recently become recognised, but this cleaning process has been more particularly applied preparatory to the production of the thick deposits, in connection with which it will be discussed later.

(*To be continued.*)

THE PROPERTIES OF ARACHIN AND CONARACHIN AND THE PROPORTIONATE OCCURRENCE OF THESE PROTEINS IN THE PEANUT.

By D. Breese Jones and Millard J. Horn

The Nitrogen in the Extract.

(*Continued from page* 40.)

Before proceeding with the quantitative determinations of arachin and conarachin it was necessary to study the behaviour of the peanut proteins toward certain protein-precipitating agents, in order to ascertain whether all the nitrogen in the extract represented intact protein molecules, or whether the extract also contained proteoses or peptones, or nitrogen of non-protein character.

Careful addition of a 16 per cent. aqueous solution of trichloracetic acid to 10 cubic centimetres of the fresh extract precipitated all but a negligible quantity of the nitrogen.

Behaviour of Arachin toward Trichloracetic Acid, Tannic Acid, and Tungstic Acid.

Five grams of pure, freshly prepared arachin was dissolved in 10 per cent. sodium chloride solution, and the solution diluted in a volumetric flask with water to 100 cc. Four 5 cc. portions of the solution were measured out. One portion was user for the determination of total nitrogen, the second was treated with 15 per cent. trichloracetic acid until no further precipitation occurred, the third was similarly

[36] R. W. Mitchell. "Cleaning Metals To-day." *Metal Industry (New York)*, 1925, XXIII, pp. 151-153.

[37] E. J. Dobbs, "Metal Cleaners in Use in Electro-Plating." *J. Electroplaters' and Depositors' Tech. Soc.*, March, 1926, I, pp. 9-11.

treated with an aqueous 10 per cent. solution of tannic acid, and the fourth with a mixture of equal volumes of sodium tungstate and two-thirds normal sulphuric acid. These reagents ace commonly used as specific precipitants for intact protein. The resulting precipitates were removed by filtration and washed with 10 per cent. sodium chloride solution containing a few drops of the precipitation reagent. Nitrogen was determined in the combined filtrate and washings.

In order to find out whether any free amino acids might also be precipitated by these reagents along with the protein, precipitation tests were made with arachin in the presence of a mixture of amino acids. The amino acid mixture was prepared by boiling 50 gm. of the α-globulin of tomato seed with a mixture of equal volumes of concentrated hydrochloric acid and water until the hydrolysis was completed, as shown by a negative biuret test. Most of the free hydrochloric acid was removed by concentrating the hydrolysate under reduced pressure to a thick syrup. The final residue was dissolved in water and neutralised with sodium hydroxide.

After the solution was slightly acidified with hydrochloric acid, an equal volume of 95 per cent. alcohol was added, followed hy the addition of a 10 per cent. suspension of calcium hydroxide until all the humin was thrown down, and the solution remained clear. The ammonia was then removed by distilling the mixture under reduced pressure until about half the volume had passed over. The concentrated solution of amino acids was slightly acidified and warmed with charcoal on the steam bath for an hour. The mixture was filtered, and the filtrate diluted with water to 500 cc.

Portions containing 5 cc. of the arachin solution and 0.5 cc. of the amino acid solution (which also contained 10 per cent. sodium chloride) were treated with trichloracetic acid, tannic acid, and tungstic acid in the manner described. The precipitates were filtered off and washed, and nitrogen was determined in the filtrates. Practically none of the amino acid nitrogen was precipitated with the arachin.

Quantitative Estimation of Arachin and Conarachin.

The percentage of arachin was determined by three different methods which gave closely agreeing results.

Precipitation with Ammonium Sulphate.

The wide difference in the precipitation limits of arachin and conarachin with ammonium sulphate affords an effective means for their separation.

For the quantitative estimation of arachin 500 cc. of the fresh, clear filtered sodium chloride extract of peanut meal was placed in a centrifuge bottle, and enough ammonium sulphate added to make the solution 40 per cent. saturated. After standing for several hours the mixture was centrifuged. The arachin settled as a viscous, compact layer on the bottom, from which the clear supernatant liquid could be readily decanted. The arachin was again redissolved in 10 per cent. sodium chloride solution and reprecipitated with ammonium sulphate in the manner just described. For further purification it was again redissolved in as little 10 per cent. salt solution as possible and finally precipitated by dilution with 10 volumes of distilled water. After the whole was centrifuged, the precipitate was dried by first suspending it for 24 hours each in 95 per cent. alcohol, and then in absolute alcohol, and finally in absolute ether. The white material was then allowed to stand in a vacuum desiccator over sulphuric acid. Triplicate determinations made in this manner yielded 2.85, 2.84, and 3 gm. of arachin, respectively. Since these quantities were obtained from 500 cc. aliquots of 2 litres of extract from 50 gm. of meal, they represent, respectively, 22.8, 22.7, and 24 per cent., or an average of 23.2 per cent. of the oil-free peanut meal. Even with the exercise of greatest care, some losses occurred during the purification of the arachin. Consequently these figures are somewhat low.

Estimation of Arachin and Conarachin.

Coagulation of Conarachin.

Inasmuch as it had been found that, with the exception of a negligible quantity, all the nitrogen in the fresh salt extract of the acid, and that practically all the nitrogen in the extract represented arachin and conarachin, for the estimation of arachin and conarachin advantage was taken of the wide range in the temperatures at which these two proteins coagulate. Ten cubic centimetres of the extract were slowly heated to 85° C. The coagulum was removed on a folded filter and well washed with 10 per cent. sodium chloride solution. Determination of nitrogen in the filtrate from the coagulated conarachin gave a value equivalent to 2.3 gm. of arachin nitrogen calculated for the 2 litres of extract from 50 gm. of meal. Since arachin contains 18.29 per cent. of nitrogen, the foregoing quantities of nitrogen corresponds to 12.5 gm. of arachin, or 25 per cent. of the peanut meal.

Subtracting the arachin nitrogen from the total nitrogen in the extract gave a value corresponding to 9.4 per cent. of conarachin.

Estimation of Arachin and Conarachin by Means of the Refractometer.

These determinations were based on the method described by Robertson, who showed that the change in refractive indices of aqueous solutions owing to the introduction of protein is proportional to the concentration of the protein, and conforms to the formula $n - n' = ac$, where n is the refractive index of the protein solution, n' that of the solvent, c the percentage of protein in the solution, and a a constant characteristic for the protein. Reiss had previously shown that the refractive indices of closely related globulins did not differ sufficiently to distinguish between them. In the determinations reported here it was accordingly assumed that the difference in the refractive indices of arachin and conarachin was so small as to have no material significance in the results.

The measurements were made with a Carl Zeiss refractometer, and a Palo light was used. The 10 per cent. sodium chloride extract of the meal used was found to have a refractive index of 1,3530, and that of the pure salt solution, 1.3510. The extract was heated carefully to 85° C., and the coagulated conarachin settled by centrifugalisation. The refractive index of the clear supernatant liquid was found to be 1.3525. The percentages of arachin and conarachin were calculated as follows :

Two litres, or the total extract from 50 gm. of meal, would, therefore, contain 12.70 gm. of arachin, and 4.236 gm. of conarachin, or 25.4 per cent. and 8.4 per cent. respectively, of the meal.

Estimation of Conarachin by Precipitation With Trichloracetic Acid.

One hundred cubic centimetres of the extract was made 40 per cent. saturated with ammonium sulphate, and the precipitated arachin removed by filtration. Conarachin was precipitated from the filtrate by addition of trichloracetic acid. The precipitate was filtered off and washed repeatedly with small portions of dilute trichloracetic acid until all the ammonium salts were removed. The precipitate of conarachin contained 0.03933 gm. of nitrogen. The original 2 litres of extract from 50 gm. of meal would therefore, contain 0.7665 gm. of nitrogen, equivalent to 8.4 per cent. on conarachin in the oil-free meal. The percentages obtained by the various methods are in fairly close agreement.

Examination for Prolamin.

Fifty grams of the peanut meal was stirred for four hours with approximately 1 litre of 65 per cent. alcohol. Only 1.5 per cent. of the total nitrogen in the meal was extracted. The filtered alcoholic extract was evaporated to dryness. The residue consisted chiefly of a hard, yellow material which had a sweet taste, and gave a strong carbohydrate test with Molisch reagent. It contained 0.5 per cent. nitrogen. From these results it was concluded that peanuts contain but a negligible quantity, if any, of the protein of the prolamin class.

Examination for Glutelin.

A quantity of the peanut meal was exhaustively extracted with 10 per cent. sodium chloride solution to remove the globulins, and the residue was then stirred for eight hours with 0.2 per cent. sodium hydroxide solution. The alkali extracted 4 per cent. of the total nitrogen of the meal. On acidification with acetic acid the extract yielded a brown substance which contained

1.3530 - 1.3510 = 0.0020, refraction due to arachin and conarachin.
1.3525 - 1.3510 = 0.0015, refraction due to arachin

0.0005, refraction due to conarachin

Substituting these values in the formula $n - n' = ac$. ($a = 0.00236$)

$\frac{0.00150}{0.00236} = 0.635$ per cent., or 0.635 gm. arachin in 100 cc. of extract.

$\frac{0.0005}{0.00236} = 0.2118$ per cent., or 0.2118 gm. conarachin in 100 cc. of extract.

9.52 per cent. nitrogen. The character and properties of this material were not characteristic of a glutelin. This portion represents 11 to 12 per cent. of the total nitrogen of the meal.

Summary.

Oil-free meal obtained by ether extraction of finely ground shelled Virginia peanuts was found to contain 7.36 per cent. nitrogen, equivalent to 40.48 per cent. crude protein. (N × 5.5).

Ten per cent. sodium chloride solution extracted from the oil-free meal 6.41 per cent. nitrogen, or 35.27 per cent. crude protein.

Examination of the peanut meal showed the presence of only two globulins, arachin and conarachin, present to the extent of approximately 25 per cent. and 8 per cent., respectively, of the oil-free meal.

Arachin in 10 per cent. sodium chloride solution does not coagulate even at boiling temperature of the saline solution. It has the specific rotation -39.5, and precipitates completely from its sodium chloride solution at 40 per cent. saturation with ammonium sulphate.

Conarachin coagulates at 80° C. It has a specific rotation, -42.7°, and is precipitated at 85 per cent. saturation with ammonium sulphate.

Arachin in 10 per cent. sodium chloride solution was practically completely precipitated by trichloracetic, tannic, or tungstic acids. Amino acids, if present, did not come down with the arachin. In the presence of peptone trichloracetic acid precipitated all of the arachin but none of the peptone; tannic acid precipitated 39.13, and tungstic acid 44.66 per cent. of the peptone nitrogen in addition to the arachin when both the latter were present in 10 per cent. sodium chloride solution.

No evidence was obtained showing the presence in peanuts of significant quantities of albumin, prolamin, or glutelin.

BELGIAN CHEMICAL INDUSTRY.

The development of this industry since the war has been little short of phenomenal and is still continuing. The movement, which has been supported by the leading banks, has tended towards concentration, specialisation and the manufacture of new products for which Belgium was formerly dependant on foreign countries.

INDUSTRIAL SUPERHEATED STEAM PRACTICE.

A Notable Installation in the Iron and Steel Industries.

By A Well-Known Engineer.

More and more the most scientific power station principles are being adopted for the industrial steam boiler plant, of which a typical example is of course Synthetic Ammonia and Nitrates Ltd. Very interesting also is the works of Australian Iron and Steel Ltd. at Port Kembla, New South Wales, which is a combination of British and other Australian interests. The whole equipment is on the most up-to-date lines, including for example the largest blast furnace in the British Empire, 800 tons of pig iron per 24 hours capacity, and two hot metal ladles of the mixer type, each with a capacity of 125 tons, to take the molten iron from the blast furnace to the pig casting machines, with the moulds on chain conveyers. The boiler house contains seven "Stirling" semi-vertical water-tube boilers of 55,000 lbs. evaporation per hour each, operating at 275 lbs. pressure and 540°F. superheated steam temperature, with combined stoker and waste heat firing. Superheaters of the "M.L.S." type have been supplied by the Superheater Co., Ltd., of London, and the characteristic features of this well-know design, as used also at Synthetic Ammonia and Nitrates Ltd., are the use of the single pass principle and the method of manufacturing the long loop elements, which consists in uniting several lengths of tube by means of integral return bends formed from the tubing itself. The operation is carried out with the firm's patent forging process so that single-pass superheaters of any dimensions are obtained, without the use of oxy-acetylene or electric welding. It is well known these latter methods are dependent on the personal element, whilst also it is difficult to form a welded joint that is perfectly smooth both inside and outside the tube. No such obstacle, however, exists with the machine forging process, and the joint is also thicker and stronger than the tube itself. Such correct principles of design and construction ensure uniform steam distribution of the steam, so that superheating up to 850°F., can be carried out safely when using low carbon steel.

A considerable number of installations on these lines are now at work in Great Britain and elsewhere at 750-850°F., especially in power stations, whilst other examples of industrial application are the plants of the

Bolsover Colleries Ltd. 300 lbs. pressure and 700°F., Taylor Bros. Ltd., the well-known steel firm, 350 lbs. and 750°F., and the Agwi Petroleum Corporation, 215 lbs. and 650°F., the conditions at Synthetic Ammonia and Nitrates Ltd. being 800 lbs. and 855°F. Also superheaters of the same make for conditions of 900-1200°F. are operating at the "Turner" and "K.S.G." low temperature carbonisation plants at Coalburn (Lanarkshire), and the works of the South Metropolitan Gas Co. (London) respectively.

ELECTRICITY.

By "An Ignorant Student."

What is Electricity?

Is it Movement? Is it Vibration?

Well, it may be—it may be both.

We seem to use the word in at least two senses, for a continuous stream of Electrons, current, Energy with little or no resistance to it; and also for Energy where there is resistance owing to the presence of Matter of some density which interrupts the current and so causes Vibration. The stream of Electrons is temporarily broken but as it persists there is renewal repetition and so alternation.

Electrons moving where there is little or no resistance are accelerated, and have Velocity. There is Radiation as in Light—let us say in its first phase.

But where there is present Matter of some density there is interruption, retardation, contact, and Vibration—Shall we say as in Sound?

Electricity, then, is a form of Energy active in its operation. Movement is, therefore implied. And the movement is continuous, unless there is present Matter of some density which interferes with it and resists it and then there is Vibration.

So first there is Pressure of Energy, practically unresisted. Secondly, there is pressure which is resisted. And Pressure coupled with Resistance in a progressive series is alternating and Vibratory.

Pressure and resistance, the two Forces of Energy which act in different directions to each other, that is, towards the same point, are a pair of opposites or extremes, say, active and inert, Energy and Matter.

Matter tends to be inert because the Energy in it is conserved in its density—balanced.

It is the density of Matter that resists Energy and causes Vibration.

Electrical fields and effects are results.

MAGNETISM.

And what is Magnetism?

Magnetism is that effect or behaviour of Energy which comes into operation where there is present Matter of some density. It is so closely connected with Matter that it would seem to be inseparable from it.

Magnetism comes into operation with resistance and stops Electrical current, cuts it off. It is defeative. It kills Movement. It is death to activity and tends to produce inertia. It locks up Energy in the Atom and in Matter and makes it dense, thus tending to re-establish a state of equilibrium, but an equilibrium of dense Matter not of Energy.

It is therefore somewhat of a paradox. It stops initiative by its own action—by the weight and density of accumulating Matter. It reverses the direct effect of the Pressure of Energy, and substitutes that form of inertia which is called Gravity.

The effect of Magnetism therefore is circumlocutory; it locks up Energy in dense masses; it attracts bodies of dense Matter to each other by Gravity; and by compression it makes them denser.

It thus becomes a new source of Energy.

GENERAL NOTES

COMMERCIAL UTILISATION OF ALBERTA BITUMINOUS.

According to information published by Alan E. Cameron, Secretary of the Alberta Research Council, tar of 99.5 per cent purity was extracted from the bituminous sands of the McMurray area in northern Alberta recently as the result of the development by Dr. K. A. Clark of the University of Alberta, of a process for utilising the tar sands.

The pilot plant erected at a point about a mile and a half from the railway terminus at Waterways, Alberta, is producing about a barrel of tar, or 500 pounds, for each ton of bituminous sand handled. The process has been brought to such a state of efficiency that tar extracted is showing less than one-half of one per cent of combined mineral and water matter and is claimed to be as pure as any that can be produced from any other known source.

The experimental plant which has been established at Waterways is a hot water process for separating the bitumen from the sand. Ten tons of the sand were put through the plant at that time and showed an objec-

tionable content of about 20 per cent of water. During the winter Dr. Clark concentrated on improvements in the process for the removal of water.

The plant was reassembled in April with the improved methods of extraction included and during the first week in June it was handling about two tons of the sand per hour with the result in extraction noted above. The intention is that after a few minor adjustments the experimental plant will be put into operation on a 10-hour-a-day schedule for the next two and a half or three months. In order to definitely determine the economical phase of placing the separated tar on the market, costs of handling the material and extraction are to be carefully kept.

Professor Cameron indicated that at the present stage of development, the problem is one of utilisation and it must be proven that the finished product can compete commercially with tar that is secured as a by-product from many other sources. It is also to be determined whether it is more economical to ship the tar for mixing with sand as a road dressing or to ship the raw sands for this purpose. The possible use of the bitumen, or tar, for road purposes is seen as an important phase of the development of Alberta's enormous tar sand resources. A much wider market, it is believed, lies in the petroleum field and it has been shown that modern petroleum cracking processes will produce from the separated bitumen, gasoline and other petroleum products of good quality.

MEMORANDUM ON CANADA.

His Majesty's Senior Trade Commissioner in Canada who has for many years drawn attention to the desirability of United Kingdom firms obtaining first hand information regarding the Canadian market by means of personal visits has recently revised his "Memorandum for the use of British visitors to Canada."

This memorandum contains information on a variety of subjects which should contribute to the personal comfort of any visitor to Canada and will also render him conversant with matters that are common knowedge to those acquainted with north American conditions.

CHEMICAL SOCIETY'S LIBRARY.

The Library of the Chemical Society will be closed for stocktaking from Monday, August 4, until Saturday, August 16 inclusive, and will close each evening at 5 o'clock

NOTICES OF BOOKS.

A First Chemistry for Schools. By ARTHUR BROOKS, B.Sc. Pp. 159. University of London Press, 10, Warwick Lane, E.C.4. 1930. Price 2s. 9d.

This volume, by the author of *A School Chemistry*, is intended to serve as an introduction to a more systematic study of the science by pupils in secondary schools. After a short and simple explanatory introduction the work is divided into three main sections: (1) the Preparation of Pure Substances; (2) A Study of the Atmosphere and (3) A Study of Acids and Alkalis, actually, however, the work follows on connectedly from observations on solution, suspension and filtration to the discoveries made in connection with the nature of the air and to the study of acids and alkalis.

The subject is developed historically with convenient and simple experiments to demonstrate definite chemical facts and phenomena and due regard has been paid to the applications of chemical knowledge in daily life the experiments have been well chosen and the suject matter is very well presented for young pupils, who will appreciate many of the photographs and illustrations.

The book should appeal to Science Masters and others for use with beginners.

J. G. F. D.

Grundbegriffe der Chemie. Von. DR. E. RABINOWITSCH, Göttingen. Mit 2 Figuren. 151 Seiten. Sammlung Göschen Band 804. Walter de Gruyter & Co., Berlin W.10 und Leipzig. 1930. Preis: in Leinen gebunden R.M. 1.80.

Dieses Werk stellt einen Versuch dar, die allgemeinen Begriffe, auf denen sich das Lehrgebäude der Chemie aufbaut, in möglichst klarer und zusammenhängender Weise darzustellen. Dem Studierenden der Chemie und verwandter Fächer soll es als Ergänzung zu den üblichen Lehrbüchern dienen. Es soll ihm dazu verhelfen, die chemische Sprache zu erlernen, die Fülle der von den Lehrbüchern gebrachten Tatsachen von allgemeinen Gesichtspunkten aus zu übersehen und zu beherrschen.

Das Büchlein wendet sich aber nicht auf an den Studierenden, sondern auch an den weiteren Kreis von naturwissenschaftlich interessierten Lesern, die nicht so sehr über die Einzeltatsachen der Chemie, als über die allgemeinen Ergebnisse und Zusammenhänge dieser Wissenschaft Orientierung suchen.

Die Physik, insbesondere die Atomphysik, dringt in der neueren Zeit immer

fach nicht nur eine Vertiefung, sondern auch eine Vereinfachung und Veranschaulichung der Grundlehren der Chemie. Der Verfasser heilt es daher für geboten, von diesen Ergebnissen der Physik einen möglichst weitgehenden Gebrauch zu machen. Aus diesem Grunde dürfte das Büchlein vielleicht auch für die Chemiker älterer Generation von Interesse sein, denn bekannte chemische Tatsachen werden darin vielfach von einem allgemeineren Standpunkt aus dargesteilt, als es früher möglich war.

Allgemeine und Physikalische Chemie. Von DR. HUGO KAUFFMAN, Professor an der Technische Hochschule in Stuttgart. Zweiter Teil. Mit 4 Figuren. Vierte, verbesserte Auflage. 148 Seiten. Sammlung Göschen Band 698. Walter de Gruyter & Co., Berlin W.10 und Leipzig. 1930. Preis : in Leinen gebunden RM. 1.80.

Das nunmehr in vierter Auflage erscheinende zweite Bändchen dieses weitverbreiteten Werkes ist weitgehend umgearbeitet und auf den gegenwärtigen Stand der physikalischen Chemie eingestellt worden. Unter Kürzung von heute weniger wichtigen Kapiteln haben andere eine ausführlichere Behandlung erfahren, wobei insbesondere auf die neueren Anschauungen über die Atoms und auf die Grundzüge der Quantenlehre Wert gelegt wurde. Zunächst wird der Valenzbegriff entwickelt, die chemische Konstitution erläutert und ihre Bedeutung für eine Reihe von physikalischen Eigenschaften gezeigt. Hierauf wird die Thermochemie behandelt und die Theorie der Wärmetönung und der chemischen Affinität in kurzen Umrissen dargelegt. Alsdann folgt die Elektrochemie mit den Anschauungen über die elektrolytische Dissoziatio n und die galvanischen Ketten. Hieran reiht sich die Photochemie, bei der die erforderlichen optischen Begriffe, die Art der Lichtwirkung und namentlich das photochemische Aonivalentgesetz hesprochen werden. Den Schluss bilden eingehendere Darlegungen des Aufbaus der Material der Atom — und Elektronentheorie, sowie die Lehre von der Radioaktivität. Das Büchlein bringt trotz seiner kurzen Fassung das Wesentliche und ist durch Namen—und Sachregister handlich gemacht.

We have received the capacious Price List of Fine Chemicals manufactured by The British Drug Houses, Limited, Graham Street, City Road, London, N.1.

The list of chemicals include Organic and Inorganic Chemicals, Analytical Reagents, Standard Stains, Indicators, Solutions, Minerals and Dyes.

The very high standard of purity and the reliability of the B.D.H. pure chemicals is well known.

How to Form a Company. By HERBERT W. JORDAN. Nineteenth Edition. Pp. 108. London : Jordan & Sons. Limited, Chancery Lane, W.C.2.

This book gives a brief survey of the history and formation of Companies, the advantages, and purposes, and how those purposes are best utilised.

The numerous formalities which apply to the incorporation of a Company are clearly explained.

To many the incorporation of a Company may seem a very big undertaking, but it will be found that the procedure does not involve any more than is contained in this valuable book.

The book should prove useful to those who may at any time contemplate the conversion of their businesses into companies.

My Case for Empire Free Trade. By LORD BEAVERBROOK. London : The Empire Crusade, Trafalgar Square, W.C. 1930. Price 6d.

There is a widespread impression that all is not well with Britain. Attention is directed to the increasing number of unemployed and the general trade depression. Upon such occasions it is not unusual for political nostrums to receive more consideration than their real value merits. Nevertheless any proposals that are likely to benefit mankind or alleviate distress are worthy of most careful consideration.

Lord Beaverbrook has come forward with a bold and sincere scheme having for its object the greater prosperity of the British Commonwealth of peoples by establishing "Empire Free Trade" within the British Empire. His proposals deserve the close attention of all thoughtful people. It is doubtful, however, whether they will secure the approval of England and also of the Dominions and Colonies and further whether they would achieve the expected results. The depression resulting as an aftermath of the war (similar in nature to those a hundred and two hundred years ago) are being felt all over the world. Unemployment exists in nearly all industrial lands and has increased during the last year. Yet Britain probably employs today as many workers as in 1914. [illegible]

Beaverbrook's policital arguments we will concern ourselves but little. He states his case with reason and simplicity. He is troubled by foreign goods underselling empire produce and he assumed that the other nations dump their goods on us to ruin us. If they succeed they will effectively lose one outlet for their wares. Again, the Canada—U.S.A. trade, to which attention is directed in Lord Beaverbrook's arguments, is naturally greater than the Canada-England trade owing to their close proximity.

There seems every reason to suppose that if every natiou practised complete free trade it would increase the general material prosperity of the world and serve to promote goodwill among nations, an ideal in which the men of science of the English-speaking peoples have so conspicuously encouraged as a part of their function in extending the comforts and amenities of mankind.

PUBLICATIONS RECEIVED.
U.S. GEOLOGICAL SURVEY.

Borate minerals from the Kramer District, Mohave Desert, California. By W. T. Schaller, Professional Paper 158-1. Price 20 cents.

Lithologic Studies of fine-grained Upper Cretaceous Sedimentary Rocks of the Black Hills Region. By William W. Rubey. Professional Paper 165—A Price 25 cents.

A Flora of Green River Age in the Wind River Basin of Wyoming. By E. W. Berry. Professional Paper 165—B Price 20 cents.

Surface Water Supply of the United States 1925. Part VI Missouri River Basin, Water Supply Paper 606. N. C. Grover, chief Hydraulic Engineer. Price 30 cents.

Geology and Water Resources of the Mokelumne Area, California. By H. T. Stearns, T. W. Robinson and G. H. Taylor. Water Supply Paper 619. Price $1.25.

Surface Water Supply of the United States 1926. Part IV St. Lawrence River Basin. N. C. Grover, chief Hydraulic Engineer. Water Supply Paper 624. Price 20 cents.

Surface Water supply of the United States 1926. Part V Hudson Bay and Upper Mississippi River Basins. N. C. Grover chief Hydraulic Engineer. Water Supply Paper 625. Price 20 cents.

Surface Water Supply of the United State 1926. Part VI Missouri River Basins Water Supply Paper 626. Price 25 cents.

Surface Water Supply of the United States 1926. Part VII Lower Mississippi River Basins. Water Supply Paper 627. A. C. Grover chief Hydraulic Engineer. Price 11 cents.

Water Power Resources of the Umpqua River and its Tributaries, Oregon. By B. J. Jones and H. T. Stearns. Water Supply Paper 636—F. Price 40 cents.

Surface Water Supply of Minor San Francisco Bay, Northern Pacific and Great Basins in California, 1895-1927. By H. D. McGlashban. Water Supply Paper 637—H. Price 10 cents.

Topographical Instructions of the United States Geological Survey. C. H. Birdseye, chief Typograhic Engineer. Bulletin 788.

The new World or Corke City mining District Park County, Montana. By T. S. Lovering Bulletin 811—A. Price 50 cents.

Geology and Coal Resources of the Meeker Quadrangle, Moffat, and Rio Blanco counties, Colorado. By E. T. Hancock and J. B. Eby. Bulletin 821—C. Price 30 cents.

Mining in the Fortymile District Alaska. By J. B. Mertie, Junior. Bulletin 813—C. Price 5 cents.

FORTHCOMING EVENTS IN CENTRAL EUROPE.

Reichenberg, (Liberec) Textile Fair, August 16-22. Danube Fair at Bratislava, August 24-Septemper 2. Prague Samples Fair, September 7-14.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

20131.—(I. G. Farbenindustrie Akt.-Ges.). —Manufacture of carbazole-2-7-disulphonic acid. July 2.

20238.—(I. G. Farbenindustric Akt-Ges.). —*Ketonehydrazones* of phenylhydrazine-ortho-sulphonic acid. July 3.

Specifications Published.

331,247.—(I. G. Farbenindustrie Akt-Ges.). —Manufacture of azo-dyestuffs insoluble in water.

811,347.—I. G. Farbenindustrie Akt.-Ges. —Process for the manufacture of vat dyestuff of the anthanthrone series.

Printed copies of the full Published Specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2., at the uniform price of 1/- each.

Abstract Published.

829,389.—Benzoic acid. (I. G. Farbenindustrie Akt.-Ges.; Frankfort-on-Main, Germany).

The methods of Specifications 307,343 and 329,375, according to which benzoic acid contaminated with naphthoquinones and phthalic anhydride is purified by reducing the naphthoquinones and hydrating the anhydride, the converted impurities being then leached out with water, are modified by omitting the reduction step, in the case where phthalic anhydride is the only impurity to be considered. The benzoic acid so obtained, or the alkali-metal benzoates prepared therefrom, may be further purified as described in Specification 329,375. Examples are given in which (1) benzoic acid containing phthalic anhydride but free from naphthoquinones is melted under dilute caustic soda solution; purified benzoic acid separates on cooling, and phthalic acid may be recovered from the mother liquor; (2) the impure benzoic acid is melted under an aqueous suspension of lime.

Printed copies of the full published specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2., at the uniform price of 1/- each.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

TEGLAC.

505,571.—Chemical substances for use in the manufacture of varnishes, paints and lacquers. — American Cyanmid Co., 535, Fifth Avenue, City, County and States of New York, United States of America.

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(University of London.)

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Full particulars may be obtained from The Principal, Royal Holloway College, Englefield Green, Surrey, by whom seven copies of letter of application and testimonials must be received on or before August 30th.

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NEXT WEEK.

Index Double Number.

The Index to Volume 140, (January to June, 1930) will be published next week. The price of the Index Number will be 1/-, by post 1/1.

THE PROGRESS OF NICKEL DEPOSITION IN RECENT YEARS.

By

D. J. MACNAUGHTON, A.Inst.P., A.I.E.E., AND R. A. F. HAMMOND, B.Sc., A.R.C.Sc., A.I.C. (Research Department, Woolwich).

(*Continued from page 56.*)

LARGE SCALE PRODUCTION OF PROTECTIVE NICKEL DEPOSITS.

On Iron, Steel, Copper and Brass Articles.

The most striking application of the increased knowledge acquired during recent years in nickel deposition for protective purposes is shown by the improved control of large-scale plating units. In their most advanced form, machine-driven conveyors transmit the articles through all the cleaning solutions and then into the plating tank. The conveying mechanism in the most recent types is designed so as to accelerate during the transfer of the articles from one solution to another. The nickel tank is sometimes of such a length that the plating is completed in the movement of the articles from one end to the other. These tanks may contain more than 10,000 gallons of plating solution. They are usually of wood with lead linings, although occasionally steel tanks with hard rubber linings are employed. Lead steam pipes are used for warming the solutions to a temperature usually in the range 30°-50° C. (86°-122° F.) and lead pipes are used for conveying compressed air when this is used for agitation. The solutions are continuously filtered, acid-resisting lead alloy pumps or air lifts being employed for the circulation of the solution.

Control of the solution is guided by regular analyses for nickel and acid contents and by frequent determination of pH. In some cases automatic methods are used for thermostatic control of the temperature and for bath voltage regulation, while automatic control of the pH will probably sooner or later be introduced.

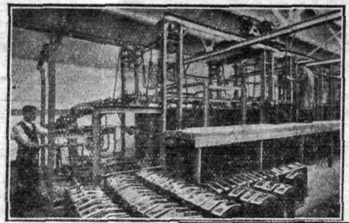
A typical sequence of automatic operations consists of

(1) Electric alkaline cleaner.
(2) Swill in water.
(3) Weak acid dips (*e.g.*, 10 per cent. sulphuric acid for steel articles).
(4) Swill in water.
(5) Plating.
(6) Cold swill.
(7) Hot swill.
(8) Drying oven.

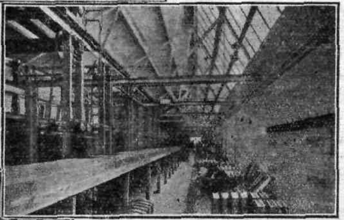
A typical solution contains :

Nickel sulphate	2 lb.
Boric acid	3 oz.
Nickel chloride or equivalent ammonium chloride	3 oz.
Water	1 gall.

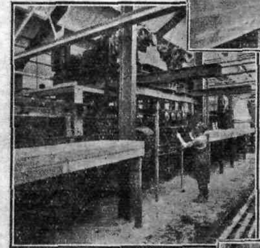
The production of a deposit at least 0.001 in. in thickness is to an increasing extent becoming standard practice. The cathode current density generally ranges from 40-50 amp. per sq. ft.—thus securing a deposit 0.001 in. in thickness in about 20 to 30 minutes—and is occasionally much higher. An example of a modern plant as used in England is shown in Fig. 9.



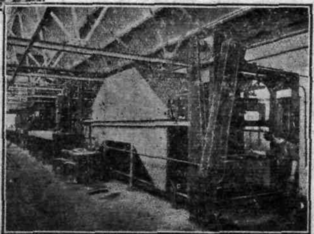
CONTINUOUS. AUTOMATIC NICKEL-PLATING PLANT at the works of Messrs. Morris Radiators, Ltd.



LOADING END showing Radiator Shells being conveyed by endless chain



GENERAL VIEW The plant is 120 feet long and the nickel vat contains 3,000 gallons of solution



MAIN GENERATORS AND SWITCHBOARD Each Generator has an output of 5,000 amps. at 6 volts.

DELIVERY END showing Steam-heated Drying Oven

On Zinc, Aluminium, and their Alloys.

Zinc and zinc base alloys, such as are extensively used for die castings, are so much less noble than nickel, that if attempts are made to plate them from the solutions of the type in general use for steel and copper, unsatisfactory results are obtained owing to the non-adherent coating of nickel that is first formed on their surfaces by chemical replacement. It is necessary to use a solution in which the deposition potential of nickel is higher than the solution potential of zinc. Such a solution can be obtained by sufficiently diminishing the nickel ion concentration. Additions of a suitable proportion of sodium or potassium citrate to an otherwise ordinary nickel-plating solution was early recognised[37] to be effective and found extensive use. Such solutions, containing an organic constitutent, are liable to deteriorate and are not effectively under control, so that alternatives were sought. Graham[39] recommended the formation of an initial ash of nickel in a solution having a nickel content sufficiently small to ensure an adequately low nickel ion concentration; the final nickel deposition is then carried out in an ordinary plating solution. Thompson[40] suggested the addition of a high proportion of sodium sulphate to a nickel-plating solution, which sufficiently reduced the nickel ion concentration by the effect of the common sulphate ion. This addition has the advantage over the use of citrates, that it is not liable to decompose and adversely affect the control of the bath.

The solutions suitable for zinc and zinc alloys are also particularly suitable for nickel-plating aluminium and its alloys, since these also are highly electro-negative to nickel once their outer coating of oxide has been removed by suitable preparatory methods. Special dips are used for this purpose.[41]

THE PRODUCTION OF SPECIALLY THICK DEPOSITS OF METAL.

Within recent years numerous applications for thick deposits of nickel have been developed. The most important of these appear to be (1) the repair by electrodeposition of worn or undersized metal parts, (2) the use of thick deposits of nickel for improving the resistance to wear and erosion of metal surfaces, (3) the production of electrotypes made entirely of deposited nickel, (4) the electro-forming of various nickel products, including tubes.

Greater difficulties have been encountered in the production with uniformity of suitably thick nickel deposits for the various purposes mentioned, than in the production of thin protective coatings. More exacting control of the conditions has been required to avoid the various defects liable to occur, and to secure deposits having suitable mechanical properties. Most of the defects which may occur in thin deposits tend to become more pronounced in thick deposits.

Pitting.

If present, this is usually a serious defect. Where perfection of surface is required, as in an electrotype, the presence of a single pit may be sufficient to spoil the entire value of the deposit. For engineering applications, pits in the deposit may lead to serious weakening of a built-up part, particularly when this is required to stand up against alternating stresses; pitting is also highly detrimental when the built-up surface is used in a position in which gas or liquid tightness is essential. The remedies for the defect, discussed in connection with thin deposits, are frequently not applicable to thick deposits owing to the fact that the conditions imposed, are liable adversely to affect the control of their mechanical properties. The importance of an exhaustive investigation into the causes of and remedies for the defect is very great, as upon the effectiveness of the control acquired over pitting will depend the magnitude of future applications of thick nickel deposits.

Roughness.

The roughness that has been discussed as occasionally occurring on thin deposits is liable to take the form of a collection of protruding nodules on a thick deposit. Avoidance of the defect by the use of highly pure materials, bagged anodes and, wherever possible, of continuous filtration is of great importance.

Peeling or Stripping.

In general, for any particular conditions of deposition, the thicker the deposit the

---

[38] L. D. Hammond. *Loc. cit.*

[39] A. K. Graham. "Electrodeposition of Nickel on Zinc." *Trans. Amer. Electrochem. Soc.*, 1923, XLIV, pp. 347-358.

[40] M. R. Thompson. "The Nickel Plating of Zinc and Zinc-base Die Castings." *Trans. Amer. Electrochem. Soc.*, 1925, XLVII, pp. 163-185.

[41] H. K. Work. "Electroplating on Aluminium and its Alloys." *Trans. Amer. Electrochem. Soc.*, 1928, LIII, pp. 361-384. See also *Metal Industry*, 1928, XXXIII, pp. 81-84 and 105-108.

greater its stress, and the greater the tendency for peeling to occur. Much greater attention has therefore to be paid to the exact control of the depositing conditions (*e.g.* current density, temperature, pH and purity of materials) than is necessary in the case of thin deposits. In cases where stopping-off, or electrotyping waxes are present, the temperature, in particular, has to be controlled within fairly close limits, in order to secure the benefit of a raised temperature in reducing the stress and at the same time to avoid the danger of melting the wax.

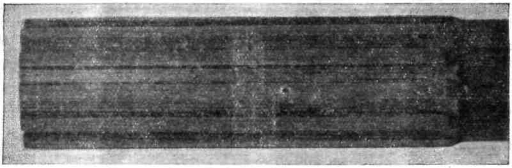
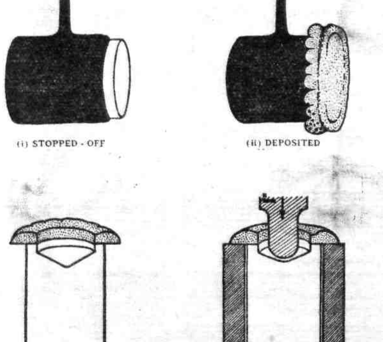


Fig. 10. A worn spline-shaft from a heavy motor vehicle which was built up by electrodeposition of hard nickel approximately 0.1in. in thickness. This photograph was taken after the repaired shaft had completed 15,000 miles of service, and shows the excellent wear-resisting properties of the deposit.

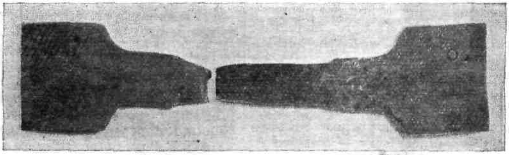


OLLARD'S ADHESION TEST FOR ELECTRODEPOSITED METALS.

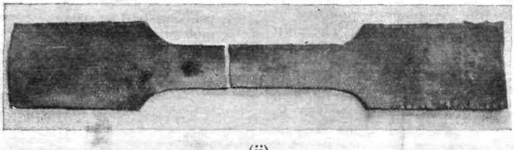
Fig. 11. A cylindrical test piece is stopped off with wax (i). A minimum thickness of about 0.1in. of nickel is deposited on the exposed end (ii). The wax is removed and the deposit machined (iii). The adhesion of the annular ring of deposit is then determined by measuring the load required to detach it from the specimen, in a suitable testing machine(iv).

Adhesion.

High adhesion is also particularly required for thick deposits on steel to be used for engineering purposes when the stresses to which the deposit is subjected in service are high. Suitable methods for obtaining adequate adhesion to common steels were developed in British Army Repair Shops during the War, and were subsequently described by Thomas[42] and by McClare.[34] It was found that great care is essential to ensure complete removal of grease and oxide films from the steel surface prior to deposition. For grease removal, a hot alkaline treatment prior to the application of stopping off waxes, followed by cathodic alkaline cleaning at 50-010 amp. per sq. ft. for several minutes, proved satisfactory. For oxide removal, dipping in hydrochloric or sulphuric acid, as used for thin deposits immediately prior to plating, did not result in sufficiently adherent deposits. Excellent results were, however, obtained by a preliminary pickle in nitric acid followed by an anodic attack at high current density (*e.g.*, 150-200 amp. per sq. ft.) in 25-30 per cent. sulphuric acid. During the anodic treatment the surface of the steel is lightly etched, and any resulting carbonaceous residue is swept away by the copious evolution of oxygen that occurs as the steel becomes passive. By this procedure such high adhesios of the subsequently formed nickel deposit to the basis metal is obtainable, that it behaves during machining, grinding and subsequent service as if it were an integral part of the steel article. Quantitative tests bv Ollard[44] (See Fig. 11) showed that the degree of adhesion attainable may be considerably above 20 tons per sq. in.



(i)



(ii)

Fig. 12. Tensile test pieces prepared fror (i) Hard Nickel, deposited in a nickel sulphate/ammonium sulphate bath. Tensile strength 71.3 tons per sq. in., elongation 2% (ii) Soft Nickel, deposited in a nickel sulphate/boric acid bath. Tensile strength 28 tone per sq. in., elongation 33%.

[42] B. H. Thomas, "The Electrodeposition of Iron as Applied to Motor Vehicle Repair Work." *Proc. Inst. Auto. Eng.*, 1920, XIV, pp. 603-634.

[43] J. P. McClare. "The Repair of Worn Components by Electrodeposition. *Trans. Faraday Soc.*, 1924-5, XX, pp. 87-96.

[44] E. A. Ollard. "The Adhesion of Deposited Nickel to the Base Metal." *Trans. Faraday Soc.*, 1926, XXI, pp. 81-87.

COPPER SULPHATE MONOHYDRATE.

By Leon J. Kay, M.A., B.Sc.

In the June issue of the *Journal of the Chemical Society*, Prof. J. R. Partington has described a method for the preparation of anhydrous oxalic acid from the common hydrated crystals.

Difficulties also arise in the preparation of other anhydrous substances and to meet these in the case of copper sulphate, a method similar to that of Prof. Partington is used in this laboratory.

The substance is required for detecting the presence of water and can, of course, be produced by simply heating the pentahydrated crystals. But direct heating is not easily controlled and the product is rarely uniform—a mixture of anhydrous and monohydrated salt is obtained. For the present purpose, the monohydrate is the more valuable—the colour change is almost as marked and there is not the delay (very considerable with strongly heated samples) often experienced with the anhydrous substance.

Hence in this case the problem is to produce the monohydrate from the pentahydrate simply and cheaply.

Dry xylene is used for this purpose. Excessive drying is unnecessary — rectified xylene is distilled (up to 140° C) after decanting from calcium chloride over which it has been standing for a few days.

Copper sulphate is prepared for dehydration by dissolving in a small quantity of hot water and suddenly cooling. The crop of very small crystals is centrifuged and dried.

These crystals, with 5-6 times their weight of xylene, are then slowly distilled from an oil-bath gradually rising to 150° C. and the monohydrate remains as a pale blue residue.

The Greenwich Central School.

FIRE EXTINGUISHERS FOR EGYPT.

The Officer-in-Charge of the Commercial Secretary's Office at Cairo reports that the Egyptian Ministry of Education is calling for tenders to be presented in Cairo by the 15th September for the supply of "Foam" and "Acid" fire extinguishers.

Firms desirous of offering extinguishers can obtain further particulars of this call for tenders upon application to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. Reference A.X. 9931 should be quoted.

ON THE MECHANISM OF RISING OF THEORETICAL FLAME PROPAGATION TEMPERATURE.

By Yuzaburo Nagai.

In the previous papers the author showed that if a small amount of ethyl bromide, diethyl selenide, tetramethyl tin or tetramethyl lead be added to hydrocarbon or to ethyl ether, the theoretical flame propagation temperature (or shortly T.F.P.T.) of the latter rises exceedingly, resulting in the narrowing of the range of inflammability of the latter. From the rising of the T.F.P.T. of a substance it also results that the larger amount of energy is required for starting ignition of the inflammable mixture containing that substance, and that the flame-speed in the mixture decreases. The T.F.P.T. of carbon bisulphide and that of hydrogen is raised not only by the addition of the above-mentioned four substances, but also by the addition of hydrocarbon.

In this paper, the author discussed the mechanism of the rising of the T.F.P.T. of combustible. He stated that the rising of the T.F.P.T. is caused by negative catalytic action of the added substances. The theory of breaking of a reaction-chain and that of catalyser-poison was discussed. It was found impossible to account for the rising of T.F.P.T. by considering that peroxide of the combustible is destroyed by diethyl selenide or other added substances. Finally the author showed that the rising of T.F.P.T. can be best accounted for by the collision of the second type between the molecules of different energy-levels.

—Department of Applied Chemistry, Faculty of Engineering, Tokyo Imperial University.

MARKING OF IMPORTED MALT PRODUCTS.

An Order in Council has been made under the Merchandise Marks Act, 1926, requiring imported malt products to be marked with an indication of origin on exposure for sale and on sale, whether wholesale or by retail, in the United Kingdom. Malt Flour, Malt Extract and Cod Liver Oil, and Malt Extract blended with any other product so that malt extract comprises more than 50 per cent by volume of the whole. The Order will come into operation on the 26th September, 1930.

The Order in Council is published as Statutory Rules and Orders, 1930, No. 566, copies of which may be purchased from His Majesty's Stationery Office, Adastral House, Kingsway, London, W.C.2. (and branches) either directly or through any bookseller, price 1d. each exclusive of postage.

SEVENTY YEARS AGO.
(From the Chemical News, Dec. 31, 1859.)

NOTE ON THE EXISTENCE OF HYPOBROMOUS ACID.

By JOHN SPILLER, F.C.S.,
Of the War Department, Woolwich.

In the course of an experimental determination of the actions respectively exerted by the elements, chlorine, bromine, and iodine upon the nitrate of silver, some few facts presented themselves which appear likely to be useful in more fully substantiating the existence of hypobromous acid.

Firstly, with regard to chlorine. If this gas be slowly passed through a cold solution of nitrate of silver, or freshly prepared chlorine water be brought into contact with the same, this latter being employed in excess, chloride of silver will be precipitated, and at the same time the solution will become strongly acid, and possessed of powerful bleaching properties, due to the oxidation of a second atom of chlorine which remains dissolved in the silver solution as hypochlorous acid. $Cl_2 + AgO.\ NO_5 = AgCl + ClO + NO_5$. This reaction, originally pointed out by Balard, I have verified more recently by weighing the amount of chloride of silver directly precipitated in that form, and also that subsequently obtained on decomposing the hypochlorous acid in the filtrate with excess of ammonia at a nearly boiling temperature; precipitating then a second porton of chloride of silver by the addition of nitric acid. These two amounts agreed so nearly as to leave no doubt of the truth of the reaction already set forth.

In performing the parallel experiment of adding bromine water to an excess of nitrate of silver solution similar appearances presested themselves. Pale yellow bromide of silver was precipitated, while a considerable amount of a bromine compound remained dissolved in the liquid, communicating to it bleaching properties, and exhaling an odour very similar to that of hypochlorous acid. Quantitative analysis demonstrated that, in this instance also, half the amount of bromine added passed directly into combination with silver, the other half remaining in solution, and existing doubtless in the form of an oxide analogous in constitution to that of the protoxide of chlorine, and to which the name of hypobromous acid (BrO) is applicable.

With iodine, under similar circumstances, a very different reaction is observed. In this case iodide of silver is formed, but unaccompanied by the simultaneous production of a bleaching compound; oxygen is set free, and apparently does not exhibit any tendency to pass on to the state of iodic acid (IO_5), the lowest oxide of iodine of which the existence has been fully established.

NEW NICKEL SMELTER IN ONTARIO.

According to a statement issued by the Internitional Nickel Company of Canada, Limited, the Frood Mine near Sudbury, Ontario, is now producing approximately 90,000 tons of ore monthly. The new smelter at Copper Cliff is in operation two months ahead of the intended date. The roasting furnaces, two reverbatory furnaces and the converters are in operation and the concentrator will be running very shortly. The acid plant built to make nitre cake is completed, and the sodium sulphate deposit in Saskatchewan is already producing and despatching soda to Sudbury. In this connection it may be recalled that the Horseshoe Lake Mining Company, Ltd., was partly financed by the International Nickel Company, with the object of developing a large deposit of natural sodium sulphate in Saskatchewan, and the material from this deposit is being delivered to the sulphuric acid plant to be erected at Copper Cliff by Canadian Industries, Ltd. The latter concern is utilising fumes from the nickel smelter for use in converting the Horseshoe Lake sodium sulphate into nitre cake in quantities sufficient to meet the refinery requirements.

The expenditure entailed by the recent expansion of production by the International Nickel Company has now reached approximately $40,000,000. As already stated, the new smelter at Copper Cliff, with a capacity of 6,000 tons of concentrates or high grade ore daily has now come into partial operation. The next development of importance in the Sudbury nickel industry will be the completion of the eectrolytic copper refinery costing $8,000,000, on which a large body of men is now working. This is the plant of the Ontario Refining Company, Limited, jointly financed by the International Nickel Company of Canada, Ltd., the American Metal Company of Canada, Ltd., and Consolidated Mining and Smelting Company of Canada, Ltd. It will have an initial capacity of 120,000 short tons of copper annually, the largest plant of its kind in the British Empire.

LIVING ON AIR.
CHEMIST'S STARTLING THEORIES.

Dr. Herbert Levinstein, President of the Society of Chemical Industry, in his presidential address to the Society at its annual meeting in Birmingham, developed some startling theories.

He predicted that the air from which our supplies of nitrogen are now synthetically obtained would also supplant synthetic fuel in place of coal, and that the world's raw materials and power would ultimately be drawn from air, water, soil, and sun.

Discussing the part of chemistry in increasing the world's food supplies, he argued that nations threatened with starvation would fight for food supplies, and that war or peace in the future might depend on this factor. He pleaded for a national agricultural policy, and described the "Manchester school" doctrine of buying in the cheapest and selling in the dearest market as "the principle of the cheap-jack who moves from fair to fair."

Another ten or fifteen generations would see the exhaustion of the world's prinicpal coal deposits. The age of coal was passing It would have lasted when it was over, for a less period than the Moorish occupation of Spain, which at the time seemed so important to Christendom, and vanished, leaving behind it nothing but a garden here and there, a palace or two preserved by the conqueror's pride, and a few romantic tales.

Dr. Levinstein quoted figures to show how water power is replacing coal power, and how the substitution of the growing plant that is timber for coal or oil was impossible. The world could not spare enough acres of actual or possible forest lands, for the world's inhabitants were wrong not only in numbers, but also in appetite.

"The directing of the great sources of power in nature for the use and convenience of man" was one of the declared objects of the Institution of Civil Engineers, and was so stated in their charter granted a hundred years ago. "This," said Mr. Levinstein, "is precisely the long range research that the Government can do, and ought to do, and does not do. It is certain. The losses of the Napoleonic wars were soon made great by the development of steam and coal. The losses of the last war can be made good by learning to use more effectually the natural forces for industrial work."

The nomination by the Council of Lord Melchett as President for the ensuing year was confirmed.

SEARCH FOR UNKNOWN PLANET TO BE RESUMED.

On March 18 last the astronomical world was startled by the announcement of the discovery at Lowell Observatory, Flagstaff, Arizona, of a new planet circling around the sun far beyond the orbit of Neptune, hitherto the most distant known outpost of the solar system. The discovery was not accidental; minute irregularities in the orbits of Neptune and Uranus had aroused the suspicion that a disturbing body existed, and several astronomers had undertaken to predict its position approximately, from an analysis of the disturbances observed. Particularly at Lowell Observatory a persistent program of search had been followed for years, in the course of which the new body was discovered.

A planet at that distance from the sun roughly some four thousand million miles, would take several hundred years to make a complete tour around the central body. Under these circumstances several years would necessarily elapse before its orbit could be definitely determined. If, however photographic images of the same body could be found and indentified on plates taken in previous years at any observatory these would serve the same purpose.

A search was immediately begun by observatories which happened to have old plates of any particular region of the sky where the object should have been at the time. Among these was the Dominion Observatory, Department of the Interior, at Ottawa, Canada. The difficulties were considerable because the plates were on a very small scale and the planet was of such faintness that it was questionable whether, with the exposure given, it would be recorded at all. Finally, on three plates taken in February, 1924, in a field crowded with innumerable stars a faint object was found which had evidently changed its position in the interval of about three weeks intervening between the first and last plates.

It was at first suspected that this was an early record of the Lowell planet. Observations had, however, been accumulating on the latter, and it was found that in 1924 it could not have occupied exactly the position in which the Ottawa object was found. It appeared therefore that the latter must be a hitherto unknown planet or comet.

On account of the small scale of the plates and the extreme faintness of the images, which were just at the limit of visibility, the measures of position which could be obtained were rather uncertain; the com-

paratively short interval between the observations adds to the difficulties in determining an orbit. If the object can be identified on other plates it will be possible to obtain further knowledge of it. At the time of writing, that region of the sky is too close to the sun for a search to be made and will remain so for several months. Later in the season fresh plates of longer exposure and on a larger scale will be made and the search continued.

The distance of the object, so far as can be judged from the material at hand, is nearly fifty times that of the earth from the sun, or somewhat greater than that of the Lowell planet.

FIRST CENTURY OF MAGNESIUM USE IN MODERN INDUSTRY.

Magnesium metal is celebrating its one hundredth birthday this year. Though known to science for 122 years, it appeared iu its present form a century ago, aud has been available commercially for more than sixty five years, Dr. John A. Gann, metallurgist of the Dow Chemical Company, Midland, Mich., says in a report to the American Chemical Society on the development of the magnesium industry.

Rapid promotion of magnesium production and utilization is characterized in the report as one of the outstanding achievements of modern chemical engineering. Airplane accessory plants, the optical and motion picture industries, machine shops and various building trades are noted as ncreasingly dependent upon the metal. Its uses are also being extended upon a large scale to the medical profession and the perfumery trade.

Further assurance of its value from the standpoint of supply is its almost universal distribution, the report points out. It is about seventy times as plentiful as nickel, and two hundred times as abundant as copper. Magnesium salts are also found in mineral waters and in the ocean, and the important raw material for magnesium production in the United States at the present time is Michigan salt brines.

The modern magnesium industry is traceable, it is stated, to the discovery of the medicinal properties of a salt in the mineral spring waters at Epsom, England, in 1695. The chemical composition of the salt was not completely established until 1808, when Davy showed that it was the oxide of a new metal which he called " magnium," a name later changed to " magnesium."

" Magnesium had a very fluctuating career until the present German industry was established a few years before the beginning of the World War," the report continues. " Great secrecy has been maintained concouerning their production statistics and methods of operation. The American industry was firmly established during the early part of the war because of our inability to import the German product.

" Because of its well-known use in pyrotechnics, the term ' magnesium ' has freqently been thought of as synonymous with ' flashlight powder,' and the metal was therefore considered to be easily combustible. This is true, however, only when it is in a finely divided state. In the massive or coherent form the metal is stable, since its high thermal conductivity prevents it from becoming locally heated to the ignition temperature.

" The use of magnesium is of considerable importance to the organic chemist. It permits the synthesis of a wide variety of compounds, including acids, aldehydes, and alcohols. Its greatest economical value occurs in the preparation of high-priced medicinal and perfumery compounds.

" The use of magnesium in magnesium-base alloys is now developing and expanding with great rapidity, and this application of the metal is destined to be the dominating factor governing the growth of the magesium industry. The most striking property of this metal is its extreme lightness. It is only two-thirds as heavy as aluminum, one-fourth as heavy as iron, and one-fifth as heavy as copper.

" The possibilities in the practical application of magnesium alloys are just becoming apparent. A few years ago they were scarcely known to industry. To-day they are available in most forms required by the designing engineer. Foundry technic, fabrication methods and alloy compositions have been so perfected that construction parts made from magnesium alloys are recognised as having the properties and stability demanded of a modern ultra-light weight metal.

" Larger production and improvements in plant operation are lowering costs to the point where magnesium is now in competition with the heavier metals. It seems safe to predict that the day is not very far distant when the magnesium industry will develop to an extent little dreamed of by those not acquainted with the properties of the metal."

GENERAL NOTES

INCREASE IN THE MANUFACTURE OF SYNTHETIC AMMONIA IN AMERICA.

According to *Chemicals* this year's production of synthetic ammonia in the United States will amount to 148,000 tons of nitrogen, and plant expansions now under way, on a scale that presages the opening of important new fields of industry, will raise this total to 290,000 tons in 1931.

Next year when this enlarged plant capacity is realized, the total American investment in synthetic ammonia plants, without taking into account plants for converting ammonia into other products, will aggregate $70,000,000.

The American industry dates from 1921, and its expansion has been entirely the result of private enterprise.

"The total consumption of inorganic nitrogen in 1928 was 415,000 tons." "The preliminary figures for 1929 show some increases over the preceeding year, namely, in fertilizers, 325,000 tons; explosives, 21,000; chemicals and acids, 63,000; miscellaneous, 25,000; refrigeration, 15,000; total consumption, 449,000 tons.

" An outstanding feature of the industry is the high cost of the complete plant from coke to ammonia, nearly two years' sales being required to turn over the plant investment. Amortization, therefore, is a very large item in the cost of production.

" Some of the requirements for success in this industry, and by that I mean ammonia production at rock-bottom costs, are large capital expenditures, a plant producing several hundred tons of ammonia per day, cheap fuel, cheap power, availability of fertilizer raw materials, proper location with regard to consuming markets, and a high order of technical efficiency.

" The production of by-product ammonia has steadily increased with the growth of the growth of the coke industry and the installation of by-product ovens, so that now the coke ovens and the gas works of the country have attained a production of over 180,000 tons of nitrogen per year. America's production of by-product ammonia, double that of any other country in the world, is a very important development. The addition of the increase production of seynthetic ammonia to the production of by-product ammonia is rapidly making the country self-supporting in nitrogen.

" If we g[illegible] see that fertilizer nitrogen, depending on its form, is selling for two-thirds to nine-tenths of its 1913 prices.

" An American process of making nitric acid by oxidization of ammonia has proved to be of lower installation cost and more efficient in operation than the processes in use in Europe, and has really revolutionized the nitric acid industry of this country; further, the use of this process has penetrated Europe, and nitric acid manufacturers in several European countries have been licensed to use this process and have put it into operation.

" The manufacture of nitrate of soda from synthetic ammonia, which Europe said could not be done economically, is being carried on in this country on a huge scale. The addition of ammonia to superphosphate, neutralizing its acidity and adding nitrogen in the most economical way, has taken hold very rapidly, and is being practiced by all the large fertilizer manufacturers.

" The expansion of ammonia synthesis abroad has now reached the state of over-production, and producing companies operating on a schedule of greatly curtailed output are keenly desirous of shipping excess production into this country.

" This new raw material, synthetic ammonia, has displaced nitrate of soda in the manufacture of nitric acid and in sufuric acid chamber plants. It has cheapened and improved manufacture of nitrogenous fertilizers and seems destined to lend a weighty contribution to the improvement of American agriculture. It is finding many interesting new uses in water purification, the preparation of hydrogen and of nitrogen, for welding, for nitriding steel, for neutralizing acids, and as a raw material in organic synthesis.

" A particular advance is the American process of producing methanol as a by-product in the synthesis of ammonia. Synthetic methanol is expected to reach a production of 10,000,000 gallons this year. It is now selling at the same price as denatured alcohol."

Outlining the development of plants in the American industry to date, Mr. Crane said:

" Since 1921, the Atmospheric Nitrogen Corporation, with great ability and broad vision, has expanded its production at Syracuse and at Hopewell to its present large volume. In 1926 production at Belle, West Virginia, began and has latterly been notably expanded.

"Meanwhile several plants have been installed for the manufacture of ammonia from by-product hydrogen, namely, the Mathieson Alkali Works and the Roessler and Hasslacher at Niagara Falls, N. Y.; the Midland Ammonia Company at Midland, Mich., and the Great Western Electrochemical Company at Pittsburgh, Cal. There is also the small plant of the Pacific Nitrogen Corporation at Seattle making ammonia from electrolytic hydrogen. It is further understood that the Shell Chemical Company is constructed a synthetic ammonia works in the vincinity of San Francisco."

CHEMICAL INDUSTRY.

Shrinkage of Share Capital Value from £147,000,000 to £77,000,000.

Nominal Capital £76,481,760.

A few weeks back the financial expert of one of the leading London daily papers dealt with the financial condition of this mammoth concern. He showed that at one time last year the shares were (he proceeds) valued by the Stock Exchange at the enormous figure of £147,300,000.

Current quotations for the shares place a value of £76,800,000 on the undertaking.

Thus, since last year investors have to face capital depreciation on their holdings amounting to £70,500,000! This year alone there has been a depreciation of close upon £24,000,000.

Steady Decline.

The company's Ordinary shares now stand at 21s. as compared with 45s. 6d. during 1929. The 10s. Deferred shares at 5s. 10½d. are 11s. 3d. below last year's figure. Even the Preference shares, the dividend on which is fixed at 7 per cent., have fallen from 27s. to 22s. 6d.

A good deal of the fall, of course, must be ascribed to general Stock Exchange conditions, and there has been no big slump. The decline has been a steady one. But during the past few days there have been disquieting rumours in circulation regarding the company's profit-earning position.

PROFITS FROM PAPER.

According to advices received from New York, Scott Paper Company reports profits for the six months ending June 30 equivalent, after prferred dividend, to $2.64 per share on the 158,009 common shares of no par value outstanding.

AMERICAN CHEMICAL INDUSTRY SELECTS FIVE LEADERS.

The five business leaders of American chemical fields are E. M. Allen, president, Mathieson Alkali Works; Leo Baekeland, chairman, The Bakelite Corporation; Pierre S. du Pont, chairman, the Du Pont companies; Herbert H. Dow, president, Dow Chemical Co.; and George Eastman, chairman, Eastman Kodak Co., according to ballots cast by the entire chemical industry. They were nominated to receive the Chemical Markets Medal to be awarded for the most distinguished economic services to American chemical industries.

Distinguished technical and scientific services to chemistry are generously awarded by medals, prizes, and fellowships, but no public recognition has, until the offering of this award, been made of business leadership in the industry founded upon chemical science. This gold medal, struck in commemoration of the Tenth Anniversary of Williams Haynes as publisher of *Chemical Markets*, the business magazine of the chemical industries, makes good this curious omission, and by vote of contemporaries and competitors, America's outstanding chemical industrialist will thus be recognised. The award will be made this Fall, at the Chemists' Club in New York, to the medalist selected from the five candidates just named.

Mr. du Pont, oldest of the three brothers —Pierre, Irenee, and Lammot—is head of the manufacturing branch of his family and chief executive of the largest chemical company in the world. The Du Pont chemical enterprise, whether judged by capitalisation, sales, or profits, is greater than the famous I. G. Dye Trust Company of Germany, or the Imperial Chemical Industries, Ltd., of Britain. Dr. Baekeland and Dr. How among the candidates represent the combination of chemist and executive. The former is the inventor of Velox photographic paper and Bakelite; but he has organised several highly successful companies and is to-day active head of the Bakelite Corporation. The Dow Chemical Company makes over 200 chemicals out of a single basic raw material, the salt brines under their gigantic plants at Midland, Mich., a feat of *manufacturing chemistry to which its* founder and president has contributed over one hundred patented processes. E. M. Allen, trained as an engineer, was called in 1920 from presidency of the Western Ore and Mining Company to reorganise the Mathieson Alkali Works. His nomination

for this medal is recognition of his development of this company in ten years from a precarious position to one of real leadership in chemical fields. George Eastman's generous gifts include many for chemical education, but in his own business he established a pioneer chemical research department. His Kodak Company during the war undertook the manufacture of rare and unusual chemicals for laboratory use, a highly valuable, practical, but non-profit-making service to chemical industry.

COMMERCIAL UTILISATION OF ANHYDRITE.

Experiments made recently by Professor A. E. Flynn at the Nova Scotia Technical College at Halifax may eventually lead to the discovery of commercial uses for anhydrite.

Anhydrite, which is abundant in the Province, has hitherto bees an obstacle to the development of gypsum mining, as separation has been necessary at considerable expense.

Professor Flynn's investigations, however, have been carried on in the hope that since the insufficiency of water in anhydrite does not permit its conversion into plaster of Paris, the pulverised mineral might be induced to act as a catalyser. In other words, a chemical reaction may be promoted, resulting in re-crystallisation. Numerous common salts were experimented with as catalysers, and with some of these, plasters were obtained far above the average in useful qualities. According to Professor Flynn:

"Summarising the results obtained in this investigation, it can be stated that plasters and cements can be made from anhydrite more cheaply than from any other mineral or rock by mixing a small amount of cheap chemical with the ground material. Plasters having a set as quick as ten minutes and a tensile strength of 300 pounds per square inch have been made by this simple process. When calcination was employed a tensile strength of 465 pounds per square inch was obtained. Also a cellular insulating plaster weighing 45 pounds per cubic foot was made by the same simple process."

If the laboratory results obtained by Professor Flynn can be translated successfully into plant practice, the value of the process in connection with the extension of the Nova Scotia gypsum industry is obvious.

£75,000,000 NITRATE COMBINED.

The approval by the Chilean Congress of a special law empowered the consolidation of the entire Chilean nitrate industry into one company was announced here today by John Pablo Ramirez, representative of the Chilean Government in Paris.

The new company will have authorised capital stock equivalent to £75,000,000, which will be issued in New York, London, Santiago and Valparaiso.

Twenty eight of the present undertakings, representing more than 91 p.c. of the productive capacity of the nitrate industry in Chile, have already approved the plan.

Among them are the Anglo-Chilean Consolidated Nitrate Corporation (American) and the Lautaro Nitrate Co. Ltd. (British), in which the Anglo-Chilean have a controlling interest. These two between them represent more than 40 p.c. of the total output, as well as the British Sabion Cello group of eight or nine small companies producing 15 p.c. of the total.

Under the law the new company will be exempt from the Chilean export tax on nitrate and iodine, which for the past three years has averaged upwards of £6,000,000 p.a. In return, the Chilean Government is to receive half the stock of the Chilean Nitrate Co., and is to have a guaranteed minimum return for the next three years of £4,500,000, £4,000,000, and £3,,500,000. After 1933 the Government will rely on dividends from its stock and the 6 p.c. income tax to compensate it for the loss of the export tax.

RUSSSIAN TRADE REPRESENTATION IN THE UNITED KINGDOM.

The Board of Trade are informed that, in accordance with the temporary Commercial Agreement between the United Kingdom and the Union of Soviet Socialist Republics, Mr. Saul G. Bron, the Trade Representative of the U.S.S.R. in the United Kingdom, has empowered Mr. Jacob Janson of Bush House (East Wing), Aldwych, London, W.C.2., to represent him and to act in the United Kingdom in respect of trade and to conclude transactions in the United Kingdom for and on behalf of the U.S.S.R.

ARTISTS' AND DRAWING MATERIALS

The Standing Committee (General Merchandise) appointed by the Board of Trade have reported on their enquiry as to whether imported artists' and drawing materials should be required to bear an indication of origin.

Proceedings & Noticies of Societies.

THE CHEMICAL SOCIETY OF JAPAN.

Papers communicated :—

"The Essential Oil of Pha-chiun." By Tessaku Ikeda.

"The Essential Oil of 'Ponkan Rind Oil." By Tessaku Ikeda and Yasuji Fujita.

"Reduction of Furfurol in the Presence of Nickel Catalyst." By Munio Kotake and Yasuji Fujita.

" Glucoside. I. Glucoside of *Panax Ginseng*, C. A. Mey." By Munio Kotake.

"A New Hypothesis on Hydroxyl and Carbonyl Radicals. IV. Synthesis of Dioxybenzanthraquinone." By Munenari Tanaka and Kiyoshi Morikawa.

"Velocity of Permeation of Electrolytes through a Membrane. II. Permeation of Alkali-earth Halides." By Shinnosuke Matsuura.

"Velocity of Permeation of Electrolytes through a Membrane. III. Comparison of Permeation of Electrolytes with Common Cation and Different Anions." By Shinnosuke Matsuura.

"X-ray Study of the System Copper-Arsenic." By Nobuki Kato.

UNIVERSITY COLLEGE, LONDON.

RAMSAY MEMORIAL FELLOWSHIPS TRUST.

The Ramsay Memorial Fellowships Trustees have made the following awards of new Fellowships for the session 1930-31 :

Mr. W. R. Angus, M.A., B.Sc., a Fellowship of £300 tenable for two years at University College, London.

Mr. K. Krishnamurti, M.Sc., D.Sc., a Fellowship of £300, tenable for one year, at University College, London.

Mr. James Bell, B.Sc., Ph.D., a Glasgow Fellowship of £300, tenable for two years, at University College, London.

Dr. A. Girardet, a Swiss Fellowship of £300, tenable for one year, at the University of Edinburgh.

The Trustees have renewed the following Fellowships for the same session :

Dr. H. Erdtman (Swedish Fellow), University College, London.

Dr. A. Klinkenberg (Netherland Fellow), University of Cambridge.

Professor Y. Nagai (Japanese Fellow), University College, London.

Dr. Lloyd M. Pidgeon (Canadian Fellow), University of Oxford.

MERCHANDISE MARKS ACT, 1926.

Air and gas compressors, pneumatic tools and appliances and parts thereof.

The Board of Trade have referred to the Standing Committee appointed by them under the Merchandise Marks Act, 1926, an application for an Order in Council to requir imported goods to bear an indication of origin :—

(1) Air and gas compressors and exhausters, and beds, casings, cylinders, rotors and heads therefor;

(2) Pneumatic tools and appliances, including mining coal cutters operated by compressed air, and cylinders, heads, piston and valves therefor.

Representatives of any interests substantially affected by the application who desire to be heard in opposition at the Public Enquiry, which will be held later by the Committee, should communicate with the Secretary, Mr. E. W. Reardon, at the Board of Trade Offices, Great George Street, London, S.W.1., as early as possible and in any case not later than 31st August, 1930.

NOTICES OF BOOKS.

The Spirit of Chemistry. By ALEXANDER FINDLAY. Pp. xvi + 480. London : Longmans, Green & Co. 1930. Price 10s. 6d.

Prof. Findlay excels as an interpreter of science for the general educated public. The present volume is particularly intended for students who do not intend to follow a scientific calling, but who wish to acquaint themselves with the intellectual progress of recent years and to gain some knowledge of chemistry, which science now enters so largely into present-day civilisation.

He describes, generally in a historical setting, the more important advances and discoveries in chemistry through the ages and to show how they have been correlated into laws and general principles which have guided further research and discovery. General interest in this fascinating account of the development of chemistry is further sustained by interesting biographical sketches of the lives of some of the outstanding men of science who have made notable contributions to our knowledge and to the elucidation of obscure phenomena.

Whilst the earlier chapters are concerned mainly with fundamental facts and discoveries, the later chapters give admirable accounts of modern developments both pure and applied so that the general reader is left in no doubt as to the essential importance of chemical science in almost every industry and department of modern life. The work is profusely illustrated with

portraits and plates and is one which should be even more widely read than Prof. Findlay's earlier *Chemistry in the Service of Man.*

PAPER MAKERS' DIRECTORY.

The 1930 edition of *The Paper Makers' Directory of all Nations*—its 89th annual issue—has just been published (cloth bound, pp. 1100, 21s. net), by Dean & Sons, 29, King Street, London, W.C.2.

In this Red Book of the Paper industry will be found detailed particulars regarding the paper, pulp, and board mills of the world, such as location, productions, number and width of machines, tonnage output, power used, telegraphic addresses, etc., as well as lists of British wholesale stationers, paper merchants, rag merchants, and paper stock dealers, china clay prodcers and merchants, cardboard box manufacturers, paper bag makers, and paper agents, with the mills they represent; the mill productions, too, are classified under 400 trade headings, alphabetically arranged as to products, countries and mills.

The Classified Index to Commercial Prospectuses (pp. xiii to xxx) forms a buyers' guide of special interest to those connected with the paper trade, both at home and abroad.

ECONOMIC CONDITIONS IN PORTUGAL.

H.M. Commercial Secretary at Lisbon has forwarded to the Department of Overseas Trade a *Report* (Price 2s., from H.M. Stationery Office) on the economic conditions in Portugal, together with notes on Angola, Mozambique and the Cape Verde Islands. From it we learn that there has been recently a marked improvement in the country's financial position and prospects. Imports, excluding foodstuffs, in 1929 amounted to £18,688,000. Coal and much machinery are obtained from Great Britain. Exports in 1929 amounted to £10,782,396, of which nearly a quarter were to Great Britain. Raw chemical materials, *e.g.*, turpentine, cork, tin ore, pyrites, olive and other oils and rosin constitute a large share of Portugal's exports, the chief of which, however, is still wine.

The unemployment figure in Austria at the end of June was 149,972, or 110,000 more than in June, 1929. Germany now has 1,833,000 unemployed, which is 900,000 more than a year ago. In Poland the number of unemployed has begun to decline. In March it reached a maximum level of 296,000, but it has now fallen to 228,381, which is, however, over 100,000 more than the number registered in June, 1929.

PUBLICATIONS RECEIVED.

Department of Scientific and Industrial Research.

Building Research.

Hot Cement. Roy. 8vo, ppr. wpr.; pp. iv + 10, with 2 diagrams. Bulletin No. 7.

Ontario Geological Reports.

Geology of the Sapawe Lake Area, with Notes on Some Iron and Gold Deposits of Rainy River District. By J. E. Hawley.

Lead and Zinc Deposits, Dorion and McTavish Townships, Thunder Bay District. By J. E. Hawley.

Boston-Skead Gold-Copper Area, District of Timiskaming. By L. V. Bell.

Oba Area, District of Algoma. By J. E. Maynard.

Ore Deposits near the North Shore of Lake Huron. By S. E. Moore.

The Cartier-Stralak Area, District of Sudbury. By F. F. Osborne.

Description of the Highwood Jumping Ground Anticline. By Dr. G. S. Hume.

Copies of the above are obtainable from Canadian Building, Trafalgar Square, S.W.1., or Ontario Government Office, Inveresk House, Strand, London, W.C.2.

Geology and Oil Resources along the Southern Border of San Jaoquin Valley, California. By H. W. Hoots. Bulletin 812-D. Price 50 cents.

Geology of the Eagle-Circle District, Alaska. By J. B. Mertie, Jr. Bulletin 816. Price 50 cents.

U.S. Bureau of Commerce.

The Commercial Standards Service and its value to Business. Commercial Standard CSO-30. Price 10 cents.

Bismuth. No. 882. Price 10 cents.

Hickory Golf Shafts. Commercial Standard CS18-29. Price 10 cents.

Safety Code for Brakes and Brake Testing. No. 107. Price 5 cents.

Foundry Patterns of Wood. Commercial Standard CS19-30. Price 10 cents.

Scientific Papers of the Institute of Physical and Chemical Research.

Uber die Bestimmung der Teilchengrosse Pulverformiger Substanzen. Von K. Kasai. No. 242. Price 75 sen.

On the Combination Series of Helium. By Y. Ishida and T. Tamura. No. 241. Price 45 sen.

Volumenanalizo de Magnezjaj Saloj. II. By De T. Maeda kaj R. Syôzi. No. 243. Price 20 Sen.

La Solvebleco de Kalico Sulfata en A Kvosolvajoj de Alkoholoj. By De T. Yamamoto. No. 244. Price 20 sen.

SCIENTIFIC PAPERS OF THE INSTITUTE OF PHYSICAL AND CHEMICAL RESEARCH, TOKYO, JAPAN.

No. 246. On the Physiological Role of Carotin and Allied Substances. By Kozo Kawakami and Ryang-ha-Kimm.

No. 249. The Band Spectra of OIO_4 in Gaseous State and in Solutions. By Sechis Kato.

No. 250. An Attempt to Prepare Higher Unsaturated Alcohols from Certain Drying Oils. By Sin'iti Kawai.

No. 251. 4'Iodo-biphenyl-4-isocyanate as a Reagent for Alcohol. I—Corresponding Urethanes derived from Fatty Unsaturated Alcohols. By Sin'iti Kawai.

No. 252. 4'-Iodo-biphenyl-4-isocyanate as as Reagent for Alcohols. II.—Corresponding Urethanes derived from C_1-C_{18} Normal, Saturated, Primary Alcohols. By Sin'iti Kawai and Kunisburo Tamura.

Forthcoming Events.

INSTITUTE OF METALS.

SOUTHAMPTON MEETING.

The Southampton Meeting of the Institute of Metals, to be held by invitation of the Mayor and Corporation of Southampton on September 9-12, promises to be exceptionally interesting—judging by the programme of the meeting that has just been issued by the Secretary.

The proceedings will be opened on September 9, when the Ninth Autumn Lecture will be given by Professor D. Hanson, D.Sc. (Vice-President), on "The Use of Non-Ferrous Metals in the Aeronautical Industry."

On September 10 the proceedings will open at the unusually early hour of 9.30 a.m., when a Civic welcome will be given to the Members by the Mayor of Southampton (Councillor Hector Young) in the Chautry Hall. Following this official opening of the Conference the Members will spend three hours discussing half a dozen metallurgical papers, several of which will be contributed by distinguished metallurgists from abroad. Meanwhile the Ladies not attending the meeting will visit the Tudor House and the Old Town Walls.

Following a luncheon at the South Western Hotel, visits will be paid during the afternoon to Portsmouth Dockyard (by steamer), Romsey Abbey and Winchester (by motor coach), the Supermarine Aviation Works at Hythe and Woolston, and the Ordnance Survey Office. In the evening there will be a Reception and Dance in the Royal Pier Pavilion by invitation of the Mayor and Corporation.

On September 11 the Members will resume the discussion of Papers at 9 a.m.—the ladies meanwhile proceeding on a motor coach trip to Netley Abbey—and at 12.30 p.m., the "business" side of the Conference will be formally concluded, when Members and their Ladies will be conveyed to R.M.S. "Mauretania" where they will be entertained to luncheon on board by invitation of the Cunard Steamship Company. After luncheon there will take place a series of visits, including an inspection of R.M.S. "Mauretania," and visits to the Floating Dock, International Cold Storage & Ice Company, Ltd., Harland & Wolf, Ltd., John I. Thornycroft & Co., Ltd., the Ordnance Survey Office, and Romsey Abbey and Winchester. In the evening a visit will be paid to the Empire Theatre.

On the concluding day of the meeting—September 12—a choice of two all-day excursions is offered—a motor trip in the New Forest and a motor trip round the Isle of Wight.

For the convenience of visitors who have the week-end free, and who desire to cross the Channel and return in an Atlantic liner, a trip to Cherbourg and back, with an extension to Dinard by motor coach, has been arranged. The party will leave Southampton at noon for Cherbourg, in the R.M.S. "Mauretania," spending the night of September 13 in Cherbourg. On September 14 there will take place a motor coach trip to Dinard via Coutances, Granville, Pontorson and Dinan, the night being spent at Dinard.

On September 15, starting from St. Malo and passing through Paramé, the route will be by Mont St. Michael—where a stop will be made for lunch and to inspect the famous abbey—and thence via a number of interesting towns in Brittany and Normandy to Cherbourg, where the night will be spent.

On September 16 the party will return to Southampton in R.M.S. "Aquitania."

The trip should be a particularly attractive one as it can be made at an inclusive charge of £8 15s.

Applications from persons desirous of taking part in the meeting and excursions

should be addressed to the Secretary of the Institute of Metals, Mr. G. Shaw Scott, M.Sc., 36, Victoria Street, London, S.W.1.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

20,825.—(I. G. Farbenindustrie Akt.—Ges.)—Manufacture of triazine derivatives. July 9.

20,827.—(I. G. Farbenindustrie Akt.—Ges.)—Manufacture of derivatives of 3-nitro-4-hydroxy-benzamide. July 11.

21,081.—(I. G. Farbenindustrie 3kt.—Ges.)—Manufacture of iodomethane sulphonic acid &c. July 11.

Specifications Published.

331,537.—Loveluck, R. J., Beckett, E. G. Thomas, J., and Scottish Dues, Ltd.—Production of anthraquinone derivatives.

Printed copies of the full published specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2., at the uniform price of 1/- each.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

CORONET.

521,600.—Photographic chemicals.—Faudels, Ltd., 36-40, Newgate Street, London, E.C.1. June 16th. Associated).

TRICOSALICIC.

511,934.—All goods in class I which includes chemical substances used in manufactures, photography, or philosophical research, and anti-corrosives.—Chemische Fabrik Grunau Landshoff and Meyer Aktiengesellschaft, Copenicker—strasse 44, Berlin-Grunau, Germany. July 16th. (Associated).

ROYAL HOLLOWAY COLLEGE.

(University of London.)

ENGLEFIELD GREEN, SURREY.

The Governors invite applications for the post of

DEMONSTRATOR AND ASSISTANT LECTURER

in the Department of Chemistry, for October, 1930. The post is resident and open to women only.

Full particulars may be obtained from The Principal, Royal Holloway College, Englefield Green, Surrey, by whom seven copies of letter of application and testimonials must be received on or before August 30th.

BRICK KILN PATENT FOR DISPOSAL.

Mr. V. Lastovicka, of the Japan and China Trading Co., 56, Rasin Embankment, Prague, Czechoslovakia, is open to receive offers for the exploitation of his patented "Tunnel" Brick Kiln Construction in Great Britain and Dominions and Colonies. NEW PATENTS.

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THE PROGRESS OF NICKEL DEPOSITION IN RECENT YEARS.

By
D. J. MACNAUGHTON, A.Inst.P., A.I.E.E., AND R. A. F. HAMMOND, B.Sc., A.R.C.Sc., A.I.C. (Research Department, Woolwich).

(*Concluded from page 69.*)

THE MECHANICAL PROPERTIES OF THICK DEPOSITS.

(1) *Hardness.*

For most of the purposes for which thick deposits are required, the strength and hardness of the deposit require to be within certain limits.

In 1924 one of the authors showed that from[45] solutions of nickel sulphate and ammonium sulphate and a small proportion of chloride, deposits are obtained having a Brinell Hardness range of about 350-400; whereas from solutions containing nickel sulphate, boric acid and a small proportion of chloride the deposits range in hardness from 160-250. The harder deposits were found later[46] to have a high tensile strength (70-80 tons per sq. in.) and low elongation (2-5 per cent.), and are particularly suitable for use where high resistance to wear is required. The softer deposits have a lower tensile strength (25-30 tons per sq. in.) and high elongation (30-35 per cent.), and, while not so resistant to general wear, are particularly suitable for purposes where deformation without cracking is essential.

As the solutions containing ammonium sulphate have a low maximum nickel content, the production of hard deposits from these solutions requires to be carried out at lower current densities than from the other type of solution which has a higher nickel content.

Attempts have been made to modify the latter type of bath, so that harder deposits may be obtained without serious reduction in the nickel content. Blum[47] found that by the addition of suitable amounts of sodium fluoride the tensile strength of the deposit is increased. Later Thomas and

[45] D. J. Macnaughtan. " The Hardness of Electrodeposited Iron, Nickel, Cobalt and Copper." *J. Iron and Steel Inst.*, 1924, I, pp. 409-424.

[46] D. J. Macnaughtan and A. W. Hothersall. *Loc. cit.*

[47] W. Blum. " The Use of Fluorides in Solutions for Nickel-Plating." *Loc. cit.*

Blum[48] found that the scratch hardness was raised by the addition of large amounts of sodium sulphate.

Macnaughtan and Hothersall[49] found these modifications do not yield deposits of as high hardness as those from the solutions containing ammonium sulphate, and that the use of fluorides seriously reduces the anode and cathode efficiency, while the addition of large amounts of sodium sulphate greatly increases the stress in the deposit.

It would appear that, in spite of their lower nickel content, baths containing ammonium sulphate will continue to find application for purposes where high hardness and high resistance to wear are of importance, *e.g.*, for certain engineering purposes and also, as recent work by Blum[50] has shown, for the production of nickel electrotypes.

(2) *Embrittlement of the Deposit.*

In general, hard deposits are less ductile than soft deposits, and to this extent are more brittle. Embrittlement of deposits may, however, arise from a variety of conditions, and in such a manner that a relatively soft deposit may be quite brittle. The embrittlement may be due to occluded hydrogen, to co-deposited oxides and, in certain cases, to included organic matter. Madsen[51] found that pronounced brittleness in soft deposits may occur at red heat owing to the presence of small amounts of impurities in the deposit. Further investigation is required into the causes of brittleness of nickel deposits. The most effective control, so far developed, consists in the use of highly pure anodes and solutions, and careful supervision of the conditions of deposition.

A small periodical addition of hydrogen peroxide to the solution is claimed to be beneficial in eliminating brittleness arising from organic matter.

(3) *Embrittlement of the Basis Metal.*

It was nearly found that when steel is pickled in acid or plated under conditions where hydrogen is discharged at the cathode, brittleness is liable to be produced. This peculiarity was found to occur to a remarkable extent in the pickling and plating of steel springs, which not infrequently cracked during such treatment.

Johnson,[52] in 1875, showed that the embrittlement, caused by immersion of iron or steel wire in acid, is sufficiently pronounced to cause a marked decrease in the number of bends which the wire can subsequently withstand before breaking. He advanced the view that such embrittlement is due to absorbed hydrogen.

In 1917 Coulson,[53] showed that, whereas during cathodic pickling steel becomes embrittled, this does not occur during anodic pickling. Later Langdon and Crossman,[54] showed that the embrittlement of steel during pickling is partly permanent, being caused by the roughening of the surface by the acid, and partly temporary, probably due to occlusion of hydrogen. Pickling in nitric acid avoids the latter type of embrittlement. Recovery from hydrogen embrittlement takes place (a) by exposure of the steel article to the atmosphere for 3 days, (b) by heating to 100°C. in air for 2 hours, or (c) by heating to 150°C. for 10 minutes.

It thus appears that embrittlement may result during such preparatory cleaning processes of steel prior to nickel-plating, as cathodic cleaning in alkali and dipping in sul phuric acid as well as during the process of plating. When it is important to avoid any pronounced tendency to embrittlement, as in the plating of hard tempered steel articles electrolytic cleaning in alkali should preferably be replaced by boiling, or air agitate alkaline solutions; pickling should, if poss ible, be restricted to an oxidising acid such as nitric acid followed by anodic cleaning in sulphuric acid; finally, the articles after plating should be subjected to a suitable heat treatment.

[48] C. T. Thomas and W. Blum. "The Protective Value of Nickel-Plating." *Loc. cit.*

[49] *Loc. cit.*

[50] W. Blum and J. H. Winkler. "Nickel Electrotyping Solutions." *Trans. Amer. Electrochem. Soc.*, 1928, LIII, pp. 419-433.

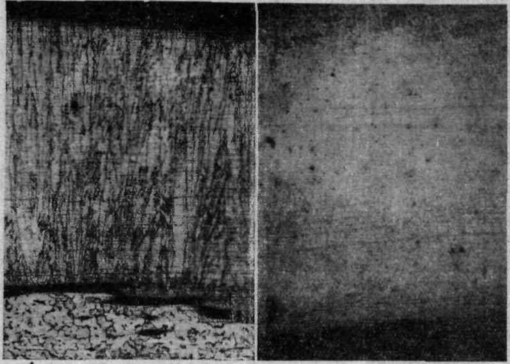
[51] C. P. Madsen. "Mechanically Perfect Electrolytic Nickel." *loc. cit.*

[52] W. H. Johnson. "Some Remarkable Changes Produced in Iron and Steel by the Action of Hydrogen and Acids." *Proc. Roy. Soc.*, 1875, xxiii, pp. 168-179.

[53] J. Coulson. "The Electrolvtic Pickling Process and its Effect on the Physical Properties of Iron and Steel." *Trans. Amer Electrochem. Soc.*, 1917, xxxii, pp. 237-243.

[54] S. C. Langdon and M. A. Grossman. "Embrittling Effects of Cleaning and Pickling upon Carbon Steels." *Trans. Amer. Electrochem. Soc.*, 1920, xxxvii, pp. 543-576.

Sutton[55] found that the hydrogen embrittlement of the underlying steel is not so readily removed by low-temperature heat-treatment once its surface has been covered with a deposit of zinc. Similar considerations may apply in the case of nickel deposits. This appears to require further investigation.



(i) (ii)

Fig. 13.—Photomicrographs of electrodeposited nickel. (i) *soft nickel deposit showing coarse crystalline structure.* (ii) *Hard nickel deposit showing fine crystalline structure.*

(4) *The Structure of the Deposit.*

The crystalline appearance of a deposit is greatly influenced by the conditions of deposition. In 1904 Bancroft[56] stated that, in general, the production of a fine grained deposit is favoured by a high current density, by high potential difference, by acidity, by low temperature and by colloids.

Blum,[57] from a study particularly of copper deposits, confirmed Bancroft's conclusions, and emphasised that the conditions that increase the cathode potential between the cathode and the adjacent solution tend to cause a decrease in the average size of crystals of the deposit. Thus, increase in current density tends directly to increase the cathode potential; dilution, cooling, adding a salt with a common ion to that of the metal salt, the forming of complex ions, the addition of colloids which retard diffusion into the cathode film—all tend to reduce the metal ion concentration in the solution adjacent to the cathode and thus to increase the cathode potential, these conditions, therefore, favour the production of small crystals.

Later Blum and Rawdon[58] put forward a comprehensive hypothesis to explain the manner in which the cathode potential influences the crystal structure.

Microscopic examination of deposits of nickel show that the average crystal size of the harder type of deposit is distinctly smaller than that of the softer type of deposit (See Fig. 13). It is not, however, proved possible to establish that marked differences in cathode potential correspond to the differences in crystal structure. A factor which may greatly influence this relationship is the hydrogen which is dis-

[55] H. Sutton. Brittleness of Zinc-plated Steel." *Trans. Faraday Soc.*, 1925, xxi, pp. 91-98.

[56] W. D. Bancroft. "The Chemistry of Electroplating." *Trans. Amer. Electrochem. Soc.*, 1904, vi, part 2, pp. 27-35.

[57] W. Blum. Factors Governing the Structure of Electrodeposited Metals." *Trans. Amer. Electrochem. Soc.*, 1919, xxxvi, pp.213-241.

[58] W. Blum and H. S. Rawdon. "The Crystalline Form of Electrodeposited Metals." *Trans. Amer. Electrochem. Soc.*, 1923, xliv, pp. 397-419.

charged simultaneously with the nickel. Not merely does the inclusion of atomic hydrogen in the deposit affect its cathode potential, but it appears there is a possibility that its co-deposition in the deposit may influence the structure in some way, as for example, by interfering with crystal growth or by the formation of nickel-hydrogen solid solutions. It is also possible that the co-deposition of hydrogen with nickel has an important bearing upon the existence of stress in the deposit[59]. On the other hand the likelihood of co-deposited oxides interfering with the crystal growth and resulting in a refinement of the grain size requires examination.

Although considerable advances have been made in recent years, it appears that much investigation is still necessary in order to obtain a fundamental knowledge of the manner in which the structure and physical properties of nickel deposits are determined by the conditions of deposition.

EDUCATIONAL OPPORTUNITIES FOR YOUNG MARINE ENGINEERS.

The Council of the Institute of Marine Engineers desire to remind young engineers and apprentices of the educational advantages afforded by association with the Institute. Apprentices or students intending to become marine engineers are admitted as graduates on furnishing proof of apprenticeship and studentship at a recognised technical school or college. The Institute's annual examination for student graduateship and the accompanying diploma, open to graduates and others not yet associated with the Institute, will be held on April 13 to 16, 1931, at centres arranged to suit candidates. The superintendent engineers of the leading shipping companies recognise that possession of this diploma is proof of all-round ability in the technical subjects specially required as the foundation of a successful career as a marine engineer. Of particular appeal is the annual offer of the Lloyd's Register Scholarship, value £100 per annum, and tenable for three years at an approved university; the next examination for the scholarship will be held on May 11 to 12, 1931, at various centres. Full particulars may be obtained from the Secretary, Institute of Marine Engineers, 85, The Minories, London, E.C.3.

59 V. Kohlschutter. *loc. cit.*

OXIDATION OF ARSENITE INTO ARSENATE.

By YOGORO KATO AND TORU MURAKAMI.

Arsenates are used extensively as insecticides and many processes for their preparation from As_2O_3 have been proposed. They may be classified into two types: the dry processes and the wet. In the former, higher temperature than in the latter is applicable which makes the reaction velocity larger, but the loss of As_2O_3 is not small. By using a suitable catalyst in the wet processes, it is capable that the oxidation is smoothly carried out. Metallic copper or cupric sulphate was proposed as a catalyst in an American patent, and Reinders and Vles explained the mechanism of its catalytic action. The present writers studied the oxidation of sodium arsenite solution by oxygen in presence of copper oxide or cupric sulphate and the result of their experiment are summarised as follows:

1. The velocity of the oxidation is nearly proportional to the quantity of NaOH added to the solution, and with NaOH less than corresponding to Na_3AsO_3, it is very small.
2. In the solution containing NaOH more than corresponding to Na_3AsO_3, cupric oxide (or hydroxide) is produced, which seems to act as a good catalyst.
3. CuO, therefore, can be used as the catalyst instead of $CuSO_4$.
4. Complete oxidation of the arsenite within a few hours is possible with an excessive NaOH and a suitable amount of CuO.

ERRATA TO NOTE ON SOME ATTEMPTS TO CONDENSE PHENYLTHIOCARBIMIDE WITH THE HYDRIDES OF ARSENIC AND PHOSPHORUS.

By R. F. HUNTER, D.Sc., Ph.D., D.I.C., A.R.C.S.

The formulæ for the prospective synthesis on page 50 should read:

(I) PhNH.CS.AsH_2

↓

(III) $C_6H_4 < \begin{matrix} S \\ N \end{matrix} > C.AsH_2$

and a similar process should be formulated for the synthesis of the phosphinobenzthiazole on page 51. There is no question whatever of reversibility, as suggested by the printers' error in the current issue of the *Chemical News*.

Brighton Technical College.
26 July, 1930.

SEVENTY YEARS AGO.
(From the Chemical News, Dec. 31, 1859.)

THE ACTION OF OZONE ON SOME ORGANIC MATTERS.

By M. BESANEZ.

M. Besanez has found that on the following substauces ozone has no action : urea, hippuric acid, allantoin, alloxan, creatine, leucine, fibrine, gelatine, starch, sugar, inosite amygdaline and salicine.

Cyanide of potassium rapidly absorbs ozone, and is changed into the cyanate. Uric acid diluted with water, and agitated with ozonised air, is dissolved and changed into allantoin and urea.

Creatinine is moderately acted on, the products being creatine, and an acid, the nature of which the author will describe hereafter.

The action of ozone on albumen is very curious. M. Besanez hoped to find urea among the protein bodies; but although he directed his attention particularly to this point he was disappointed. Not an atom of the compound was produced, and the author does not believe in the transformation of albumen into urea by oxidation with hypermanganate of potash.

In contact with ozonised air, albumen becomes slightly coloured, and then forms a coagulum somewhat analogous to fibrine, but insoluble iu a solution of nitrate of potash. After some time this coagulum liquefies, and when the liquid ceases to absorb ozone, it is no longer coagulated by heat nor precipitated by mineral salts, always excepting the tribasic acetate of lead. By evaporation in a water bath it leaves a brownish residue, which is partially soluble in alcohol. The principal result of this experiment, according to M. Besanez, consists in the formation of a compound similar to that produced when albumen is acted on by gastric juice.

The action of ozonised air on casein resembles the action on albumen. When milk is operated on, the casein is first modified, the fatty matters resist longer, and the lactine is not at all affected.

Amylic alcohol acted on by ozone gives first valerol and then valerianic acid.

Oil of cinnamon condenses a large proportion of ozone without being oxidised, but yields it up to substances more easily affected. In this way ozonised oil of cinnamon rapidly decolorises solutions of indigo.

Purified bile is not acted on by ozone : but fresh bile is quickly decolorised, the action being limited to the destruction of the colouring matter, and perhaps also the mucus.

Among the organic substances most eager for ozone is tannic acid. The author has not studied this re-action deeply; but he is certain that oxalic acid iis formed, and a body which quickly reduces the cupro-ammoniacal liquid.

M. Besanez, as regards ozone, confirms a fact remarked by M. Chevreul, *viz.*, that the presence of an alkali singularly hastens the oxydation of organic matters. The author also quotes an observation by M. His, who remarked that blood is so completely burnt by ozone that the residue is composed of scarcely anything but mineral substances. M. Erdmann has observed that ozone transforms indigo into isatine.—*Répertoire de Pharmacie.*

POTASH SALTS IN THE MARITIME PROVINCES OF CANADA.

Although commercial deposits of potash salts have not been discovered in Canada, promising indications have been encountered in a number of localities, particularly in the Maritime Provinces. At Malagash, Nova Scotia, a deposit of rock salt was discovered in 1917 and an analysis of the brine showed 0.55 grammes of potassium per litre. Since that time a number of analyses of the rock salt have shown from 0.14 to 0.20 per cent. of potassium. Potassium chloride also occurs in this locality in small lenticular concentrations in the form of crystalline masses of pink and yellowish green sylvite in a matrix of halite, resembling some of the German occurrences. The extent of these potash-bearing lenses is at present unknown, as the operations, now in progress, are aimed at the recovery of salt (sodium chloride) only. It is thought likely, however, that it may be commercially feasible to recover potash salts as a by-product from the evaporating pan. In the province of New Brunswick, about eight miles to the south-east of Moncton, a well drilled by the D'Arcy Exploration Company in a search for natural gas and petroleum entered beds of rock salt having a thickness of about 485 feet, and containing small quantities of potassium. Further drilling and sampling is necessary in order to determine whether potash salts are at present in commercial quantities.

COMBINED HEAT AND POWER SUPPLY FOR INDUSTRY.

An Important Paper at the World Power Conference.

By a Well Known Engineer.

In connection with national power supply there is no question the present principle of erecting huge super-power stations with condensing steam turbines for the supply of electricity by the "grid" system is not altogether on scientific lines. The inherent difficulty is the latent heat of steam, the fact that 60 per cent of the total heat of the coal lost in the cooling water of the condenser. Thus in Great Britain 9,000,000 tons of coal per annum are consumed in public supply electricity stations, and about 5,500,000 tons of this coal merely raises the temperature of the cooling water corresponding to about 4,000,000,000 tons per annum on the reasonable estimates of 450 tons of cooling water per ton of coal. All this vast volume of water has to be pumped, and in many cases costly cooling towers are also required because the available river is not large enough, while the thermal efficiency on the average electricity station is 15-20 per cent from the raw coal to the switchboard.

The fact that more attention is now being concentrated on this important subject is well illustrated by a noteworthy paper "Combined Heat and Power Supply in Industrial Plants" that has been read by W. F. Ryan (American Society of Mechanical Engineers) at the Second World Power Conference at Berlin. Essentially it is admitted in the paper that many industrial concerns, such as chemical works, can generate electricity cheaper than any power station when process steam is also required, by using back-pressure or pass-out engines or turbines which in average cases prevent most of the latent heat of steam loss so that the thermal efficiency is say 50-65 per cent. This is rendered all the more evident in the United States because of the enormous progress that has been made during the past half dozen years with high pressure industrial steam. Thus Ryan states that in 1929 steam at 300 lbs. pressure or over was being used on 141 American industrial plants, of which 139 had been erected since 1924. Also the paper emphasises that a huge increase in steam pressure say from 400 lbs. to 1200 lbs. in an electricity station only gives say 10 per cent. increased thermal efficiency, a relatively small item compared with the loss in the condenser. The paper by Ryan is essentially a plea for closer co-operation between industrial plant and power stations, so that the latter can sell both electricity and exhaust steam. Obviously from a theoretical point of view this is not on correct lines, although not always possible to carry out and the proper policy in Great Britain and elsewhere is to develop to the fullest extent the individual steam power and heating plant in many different industries requiring low pressure process steam, using the heat in the exhaust steam after generating power.

There is of course nothing new or untried in the matter, and for example Belliss and Morcom Ltd., of Birmingham have over 30 years experience, represented by nearly 1500 installations both engins and turbines. The best plant to use, whether back-pressure or pass-out depends upon the individual conditions, and for example Ryan states in his paper that when the power demand is large in proportion to process steam a reciprocating engine is better than a turbine, but two of the main points of the principle are flexibility and equal suitability for large and small plants.

MANGANESE DIOXIDE AND GRAPHITE FOR ANGORA.

The Commercial Secretary, His Majesty's Embassy, Istanbul, reports that the Turkish Department of Posts, Telegraphs and Telephones is calling for tenders, to be presented in Angora by the 15th September, 1930, for the supply of manganese dioxide and graphite.

Firms desirous of tendering can obtain further particulars of this call for tenders upon application to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. Reference number B.X.6684 should be quoted.

VACCINE ANTI-DIPHTERIC IN EGYPT

The Commercial Secretary to the Residency, Egypt, reports that the Egyptian Department of Public Health is calling for tenders, to be presented in Cairo by the 6th September, 1930, for the supply of 142,850 doses of vaccine anti-diphteric (diphtheria anatoxin).

Firms desirous of offering vaccine can obtain further particulars of this call for tenders upon application to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. Reference number B.X. 6674 should be quoted.

THE ASSOCIATION OF BRITISH CHEMICAL MANUFACTURERS.

The fourteenth annual general meeting of the Association of British Chemical Manufacturers was held at Burlington House, London, W.1, on July 10th.

Report and Accounts.

The Chairman (Dr. G. C. Clayton, C.B.E.), in moving the adoption of the Report, pointed out that

The membership showed a small decline, but as far as capital represented is concerned, it really covers a wide field, since the amalgamated companies have in most cases continued their membership. The position, therefore, gives no cause for anxiety. Though the number of important firms still outside the Association is small, members are again asked to do what they can to secure new members, as we desire to make our Association as completely representative as possible and the additional income which will accrue therefrom will be of material assistance in extending the new activities which the Association has taken up during the past two years.

In regard to Council membership, two of those who have been associated with us since the start and have played a prominent part in the work of the Association and in our chemical industry, have been unable to accept nomination for the coming year. I refer to Sir Max Muspratt and Sir Harold Boulton. In order to show its appreciation of their services, the Council has decided to elect them Honorary Members of Council, so that they may still keep in touch with the work of the Association and be available to assist with their experience and advice.

In none of the big foreign fairs is there a chemical exhibit comparable in magnitude, variety or interest with that of the British Industries Fair. It is hoped that the maintenance of conducted tours, mentioned in the Report, will finally dispel any mistaken ideas that may still exist regarding the capabilites of the British chemical industry to produce efficiently and cheaply the multifarious products required by modern civilisation.

For the past few years the Association has supported the Economic Section of the League of Nations by providing it with a short report on the progress of our industry. Unfortunately, very few other countries have seen their way to supply similar reports, the general excuse apparently being that of secrecy. Unless all chemical manufacturing countries of importance are willing to provide the required information, there would appear to be little point in continuing the system. This is fully appreciated in Geneva, and suggestions have been made whereby it might be possible to prepare a combined report which would show the position of the chemical industry in the world as a whole. Such a document should be of great value, but until the new system of Uniform Customs Nomenclature has been completed, and adopted by every country, no head-way can possibly be made, since there is such a wide variation in the different conntries as to the ambit of the chemical industry.

There have been no legislative measures directed specifically to the chemical industry during the year, and those likely to affect us such as the Coal Mines Bill and the Hours of Industrial Employment Bill, have been adequately dealt with through the Federation of British Industries in the case of the former and the Chemical and Allied Employers' Federation in the case of the latter. As far as the trading interests of this country are concerned, the tariff position has, if anything, become worse, and there appears little hope for any mitigation in the near future. The Council has little faith in the tariff truce, as it cannot see how the reduction of tariffs, which must be based on negotiations, can be facilitated by a truce which will tie the hands of this country on what, for practical purposes, is a non-tariff basis.

It is gratifying to be able to record further progress in the collection of statistics, as this indicates the growing appreciation of the value of accurate production data and a steady diminution in the fears of manufacturers that their individual trade would be divulged and prejudiced by participation in such schemes. When representations have to be made to the Government on behalf of a section of industry, it is obvious that these must carry far more weight if they can be substantiated by definite facts and figures, and not merely by expressions of opinion. This has become patently clear in the case of the fine chemical

industry, and one is glad to note the very thorough arrangements that have been made to collect all the statistical data bearing on the progress of that industry. As the Report indicates, schemes for other sections of chemical manufacture must wait for the final adoption of the system of Uniform Customs Nomenclature, which the League of Nations expects to be ready within the next year.

As regards the item dealing with Mr. Thomas and Industry, the Council decided, as you will note, not to make representations to the Government at this stage, but we have detailed evidence ready in case we may require to take action at any time.

The Council is in full sympathy with the scheme for Chemistry House, and hopes that all members will support it. The present is, however, an inconvenient time to have to raise money, in view of the general trade depression, but the ultimate advantages to our industry are likely to be so great that everyone should do what he can to further the success of the scheme.

The Works Technical Committee is to be congratulated on the progress that it has made in the preparation of Part II. of our Model Safety Rules. As the Report indicates, the task of collecting and digesting the large mass of information, often of a contradictory nature, must necessarily take a considerable time, and it is gratifying to note that the sections dealing with fire and explosive risks have been completed, and will shortly be printed in draft form, for submission to all members. It is the earnest wish of the Council that the publication should be made of the greatest utility to our industry, and it is hoped that every manufacturer will study the draft closely and let the Works Technical Committee have the benefit of any observations, amendments or additions which he can suggest as likely to improve the document.

French and German Associations corresponding to our own have now definitely agreed to collaborate in the preparation of this work and in our other safety activities and to provide us with all useful information which they possess. The idea underlying this collaboration has been to regard safety in industry as in the same category as medical science, and to ensure the freest and fullest exchange of information, subject only to the limitations imposed by the need for the safeguarding of the confidential details of methods of manufacture. The progress of this co-operation will be watched with the greatest interest.

On the general question of standardisation a Conference of all the chemical interests has been convened by the Association. Enthusiastic support was received for the idea of a British chemical standardising body, while the British Engineering Standards Association came forward with a proposal that its organisation should be enlarged to include all forms of standardisation, and that its name should be changed to that of the British Standards Association or something similar.

The standardisation of chemical plant is a subject of some difficulty, but the Committee which has been formed is of a very representative nature, and all possible forms of standardisation in this field will be explored. One of the basic ideas is that the request for standardisation must come from the users of the plant, that is, the chemical manufacturers, and when they have expressed a desire for any particular type of standardisation, the proposal shall be examined in conjunction with the plant makers to ascertain how far it is practicable, and if it is, to put the necessary action in hand.

The work of the Patents Committee has been of the greatest importance to our industry, and the Committee is to be congratulated on the success of its endeavours to obtain the collaboration of all the chemical bodies and societies, and to secure the acceptance of their recommendations by the Councils of these bodies. Thus the Memorandum which they submitted to the Board of Trade Patents Committee was in the name of the Joint Chemical Committee, formed by the addition of representatives from some of the other chemical institutions to our Patents Committee, and might be regarded as representing the views of the majority of the chemists and chemical interests of this country. This is, I believe, the first time that British chemistry has been in a position to speak with one voice on questions of national importance, and it is hoped that this type of collaboration may find extended scope in the future.

You may have noted that the proposals submitted by the Committee in regard to medical patents have been criticised in the Press. Practically all of these criticisms have been based on an incomplete view of the problem, and have neglected or overlooked the relationship that must necessarily exist between chemists and medical men in the discovery and development of new drugs and medicines. Success in such work cannot be achieved without the full co-operation of both parties, and the Committee's proposals were directed to a solution which should secure this state of affairs while at the same time retaining adequate protection for the British inventor and manufacturer. The problem is extremely complex and cannot be explained briefly. The Council have decided not to reply to the letters in the Press at this stage, but to wait for the publication of all the evidence which was given before the Board of Trade Committee, and then, if necessary, to publish its further observations on the subject in the light of all the opinions that have been expressed.

The section of the Fine Chemical Industry indicates the active steps which are being taken to obtain full statistical details regarding the progress made since the passing of the Safeguarding of Industries Act, 1921. While the general political situation does not at the moment call for any definite action by the Association, it is felt that it is well to have a full statement of our case ready which can be used for propaganda or other purposes when the need arises.

The position of the Dyestuffs Industry is now engaging the active attention of the Council, since the present Act is due to expire on 14th January, 1931. The Dyestuffs Industry Development Committee of the Board of Trade, on which both the dyemakers and users are represented, has been engaged for some time in the preparation of a report which will be a statement of fact to show the progress which the industry has made under the Act. At the same time, Group IX has prepared a Memorandum on the subject from their point of view and this has now been accepted by Council. The Dyestuffs (Import Regulation) Act, 1920, was passed, as you all know, to protect a key industry of vital importance to our national prosperity and safety. There have been many industrial and other difficulties to encounter since 1920, but in spite of these the Act has largely succeeded in achieving its main object, and as a consequence we have a well-organised, technically efficient and virile industry. No other form of protection would probably have achieved the same result. The following facts testify to the progress made:—

1. The 1929 production was over six times that of 1913 by weight.
2. The home production represents 90% of the home consumption by weight and 74% by value.
3. The British industry affords a more extensive range of colours than any country except Germany and Switzerland.
4. Prices have now been reduced to a level at which the burden on the consuming industries is negligible.
5. The industry has been an important competitive instrument in reducing the price of dyes.
6. British dyes are now admitted to be fully equal in quality to any foreign competitive products.
7. The British industry has played a prominent part in the discovery and development of new products.
8. An expanding export trade is being secured.
9. The industry employs a larger proportion of technically-trained men than probably any other manufacturing industry in this country.

While a sound foundation has been laid, and a strong structure is steadily being erected on efficient lines, there is still considerable headway to make before the industry can withstand unaided the intensive foreign competition and price cutting which would result if the Act were allowed to lapse. The removal of the present protection would jeopardize the consummation of the work which it was the object of the Act to achieve without any countervailing gain to the consuming industries which would make the risk worth while; in other words there would be nothing to gain and everything to lose. We shall therefore press for a further period of protection on the lines of the present Act.

GENERAL NOTES

ENCOURAGING ANGLO-ARGENTINE TRADE.

A striking proof of the anxiety of Argentina to encourage imports of British manufactures is given by a remarkable series of concessions and relaxations of National and Municipal laws for the benefit of exhibitors at the forthcoming British Empire Exhibition at Buenos Aires.

The Customs House is allowing all goods to be imported free of duty into the Exhibition provided they are re-exported after the Exhibition closes. The Internal Taxation Department is giving similar facilities in connection with goods subject to internal taxation. The Trade Licenses Department have exempted Exhibitors from the payment of any National Licences whatever.

Ordinarily, foodstuffs and some other classes of goods are subject to analysis before being admitted into Argentina. The National Chemical Office is allowing all goods for the Exhibition to come in without analysis and will, if desired, analyse samples free of charge to establish whether new products which it is desired to introduce at the Exhibition and thereafter to put on the market in Argentina, meet the regulations. Advertisement literature and free samples will probably be admitted free of duty, though the decree formally authorising this has not yet been issued.

Lastly, the Municipal Council of Buenos Aires has just resolved to exempt the Exhibition from all Municipal Taxation.

RUSSIAN TRADE REPRESENTATION IN THE UNITED KINGDOM.

The Board of Trade are informed that, in accordance with the temporary Commercial Agreement between the United Kingdom and the Union of Soviet Socialist Republics, Mr. Saul G. Bron, the Trade Representative of the U.S.S.R. in the United Kingdom, has empowered Mr. Alexei Lisareff, of Bush House (East Wing), Aldwych, London, W.C.2., to represent him and to act in the United Kingdom in respect of trade and to conclude transactions in the United King- [illegible]

USES OF MINOR ALKALI METALS.

The U.S. Bureau of Mines has just published a report dealing with studies of the minor, or rarer alkali metals—caesium, rubidium, and lithium. The last-named is more widely distributed than the other two, but all three frequently occur together. These elements, like the more familar members of the alkali group, sodium and potassium, are silvery white and tarnish rapidly in air. All are extremely light, lithium being only a little more than half as heavy as water, and the lightest element solid at ordinary temperatures. Caesium and rubidium ignite spontaneously if placed in dry oxygen at room temperature.

Most minerals contain at least a trace of caesium, rubidium and lithium, but deposits rich enough to furnish large supplies are few. Several minerals—particularly lepidolite—are rich in lithium; but only one—pollucite—is high in caesium, and no definite rubidium minerals are known.

Caesium and rubidium rarely appear on the market in their metallic states, being sold principally as salts, mainly chlorides, nitrates, and hydroxides.

The principal use at present for caesium is the manufacture of radio tubes. The caesium is introduced into the tubes in the form of chloride, mixed with magnesium or calcium, and is compressed into small tablets or " pills "; at one stage in the manufacture of the tube the pill is flashed, eliminating the last trace of air and thus securing the desired vacuum. The caesium chloride supplies positive ions at the surface of the filament.

Both caesium and rubidium are employed to a limited extent in the manufacture of photo-electric cells. Rubidium, however, appears to be more suitable for this than caesium, because an extremely thin layer can be applied on the inner side of the glass. Rubidium compounds have proven their importance as re-agents in micro-chemistry, as they form crystalline compounds readily.

Lithium minerals are used both in their natural state and as sources of salts and compounds. Lepidolite is largely used in manufacturing opal glass, for which purpose it must be free from tourmaline and other possible colouring materials. Lithium chloride finds a large use in fire- [illegible]

hydroxide is used in alkaline electrolyte storage batteries; lithium bromide and iodide in photography, and lithium carbide in Roentgen-ray experiments.

Because of its softness and rapid deterioration by water, lithium metal, as such, is not employed; but considerable research has been done to determine the possibilities of alloying lithium with other light metals. An exceptionally hard alloy has been developed in Germany, composed of aluminium, to which a very small percentage of lithium had been added. An American alloy of extreme lightness, for permanence and considerable hardness, contains lithium and beryllium, the latter protecting the lithium from oxidation by moisture or heating.—"*Canadian Chemistry and Metallurgy.*"

Proceedings & Noticies of Societies.

SOME SCIENTIFIC INSTRUMENT MAKERS OF THE 18TH CENTURY.

By ROBERT S. WHIPPLE, M.I.E.E., M.R.I.

(*Royal Institution of Great Britain, Friday, May 23, Lord Rayleigh, Sc.D., F.R.S., Manager and Vice-President, in the Chair.*)

Although numerous references are found in early British manuscripts to instruments of an elementary kind chiefly for the determination of time or position, there is little evidence that before the 16th Century scientific instrument-making as a craft had obtained a position of any importance in Great Britain. The demand for instruments to assist navigation became more insistent as new lands were discovered and the length of voyages increased.

Gradually the professional scientific instrument-maker came into existence, two of the more distinguished being Humphrey Cole, the maker of the Astrolabe used by Sir Francis Drake, and Elias Allen, the maker of Oughtred's Double Horizontal Dial. In a book by Oughtred, dated 1632, describing the Double Horizontal Dial, it is stated that it is printed for Elias Allen, "Maker of these and all other Mathematical Instruments, and are to be sold at his Shop over against St. Clements Church without Temple-barr."

With the discovery of the telescope in 1608, and its development by Galileo in the following years a great impetus was given to the instrument-making industry. Although Gregory and Newton propounded the reflecting telescopes known by their names in 1663, and 1666, they were unable to find makers capable of developing their ideas. Newton made his own instruments, but it was not until about 1730 that John Short, of Edinburgh, succeeded in making a Gregorian telescope.

The latter half of the 17th Century was a great period of scientific development. Experimental science, under its leaders Boyle, Hook, Newton and others, created a demand for scientific instruments which could only be satisfied by skilled craftsmen. The work of Hooke and Leeuwenhoek did much to develop the microscope, and to draw attention to the possibilities of the instrument. Fortunately, an instrument made about 1670, and somewhat similar in its details to that described and illustrated in Hooke's "Micrographia" (1665), has been preserved. The evidence is, I think, convincing that this instrument was made by Christopher Cocks, the well-known telescope-maker, who lived in Long Acre, and of those telescopes there are at least three in existence. It is known that in March, 1672, Cocks was ordered to make a four- or five-foot Newtonian Reflecting Telescope, but the instrument was not successful. About 1680 he was admitted a freeman of the Spectacle Makers' Company.

Owing to the publication of "Micrographia," with its description of Hooke's microscope, great interest was created in microscopical work, and a demand arose for microscopes. Owing to the high quality of the optical and mechanical work the English microscope won a high reputation.

The greatest of the English instrument makers who bridge the 17th and 18th Centuries is undoubtedly John Marshall. Nothing is known of his early life, but part of a diary recently discovered in the British Museum by Mr. H. W. Robinson, has thrown an interesting sidelight upon Marshall's career. The record covers five years of Hooke's life, 1688 to 1693, with the exception of some few months, and was thought to be the diary of James Petiver, an apothecary friend of Hooke. Mr. Robinson has been able to prove that it was written by Hooke. The following is an extract, December 14th, 1688:—"One John Marshall who told me he was Dunning apprentice & now worked at turning at the 3 keys in Ivy Lane came to shew me some microscopes of his own making

he told me Mr. Boyle had bought such of him." He appears to have set up later at the sign of the Gun as a maker of spectacles and microscopes, and there is little doubt that the microscopes were of the Hooke type. By 1690 he had built up a large business, and had introduced a new method of grinding lenses on brass tools. Marshall's Double Microscope was undoubtedly the greatest advance made in microscope construction for many years. The instrument was fitted with coarse and fine focussing adjustments, and for the first time the limb which carried the eyepiece, the object-glass and the object, formed one complete system which could be inclined as one unit. All the features are retained in the modern instrument.

The first outstanding English instrument maker in the 18th Century is undoubtedly Benjamin Martin, a man who, as far as is known, was not apprenticed to the trade. He was born at Worplesdon, Surrey, in 1704, and began life as a ploughboy, later becoming a teacher of the "three R's" at Guildford. He devoted his spare time to the study of mathematics. A legacy of £500 relieved him from the necessity of teaching, and enabled him to travel and lecture. He appears to have assisted at the lectures given by Dr. J. T. Desaguliers, which were eagerly attended by the fashionable world, and were illustrated by experiments. Horne, afterwards President of Magdalen College, Oxford, sarcastically remarked that Ben Martin "who having attended Dr. Desaguliers' fine raree gallantry show for some years in the capacity of turnspit, has, it seems, taken it into his head to set up for a philosopher." This is a hit at Martin's literary efforts, because he proceeded to publish a large number of text books dealing with a great range of subjects. When it is considered that Martin was a self-educated man, the extent and thoroughness of his knowledge, as shown in his publications, are remarkable. He appears to have lived some time at Chichester, where he kept a school, and also wrote several elementary text books and pamphlets describing scientific instruments. There is little doubt that he commenced to make scientific instruments in Chichester, not improbably being asked by the readers of his books where it would be possible to obtain the instruments mentioned.

... London to a ... Crane Court, where he became famous as a scientific instrument and spectacle maker at the sign of "Hadley's Quadrant and Visual Glasses." Martin was essentially a teacher, and continued to write after he had made his home in London. The books impress one with the care he takes to make every individual step in an explanation clear, and with the detailed drawings and references with which he explains the construction and use of an instrument. This is strikingly illustrated in his description of the various orreries he constructed. The Orrery was almost the latest scientific novelty, and Martin appears to have been much impressed with the educational possibilities of the instrument. In his "Young Gentleman and Lady's Philosophy in a continued survey of the works of Nature and Art"—a book which had a great vogue—he uses Planetaria to describe the difference between the Ptolemaic and Copernican systems, and the phenomena of eclipses, etc. He was evidently prepared to supply either form of planetarium to suit his customers' wishes. In one of his tracts published in 1771, "The Description and Use of an Orrery of a new Construction," he gives full details of the capabilities of the instrument, and also "the theory of calculations for the wheel-work of an orrery to the most extreme Degree of Accuracy." The prices of the instruments ranged from £12 12s. upwards, depending on the number of bodies demonstrated, and the accuracy of their movements, or as Martin himself states, "proportional to the work." That Martin must have continued to lecture till late in life is shown by the fact that the apparatus made is adapted to show "all the Phænomena (*sic*) of the Transits of Mercury and Venus over the Face of the Sun as I shewed in Public to Thousands on the late memorable instance of 1769."

In 1740 Martin published a useful text book on optics, "A New and Compendious System of Optics," and in many other writings took immense trouble to explain optical systems and instruments. His microscopes and especially his cabinets containing two or three instruments of various types were much sought after, and still remain as examples of first-class workmanship and ingenuity. There is little doubt that he invented the drum type of microscope which had a great vogue, and is still made in large numbers on the Continent ... class micromete

as applied to a microscope was not actually due to him he was undoubtedly one of the first to employ it. He was also one of the first to apply rack and pinion focussing adjustments to the compound microscope, and to fit inclining movements to the pillar carrying the stage and mirror.

It is a cause of wonder to me how Martin was able to produce such a large number of books. The Dictionary of National Biography mentions thirty-one, although some of them are only leaflets. Many of his books passed through several editions, and at least one was translated into French. They undoubtedly helped to popularise science and to create an interest in scientific instruments. Shortly before his death at the age of 77, he took his son into partnership, and unaware of the state of his affairs was adjudged bankrupt. He thereupon attempted suicide, and the wound hastened his death. His valuable collection of fossils and curiosities was sold by public auction for a trifling sum—a tragic ending to a more than usually successful career.

George Adams, the elder, perhaps the greatest of English scientific instrument makers, was born about 1704. It is known that he was apprenticed in 1718, and that he was established in business on his own account at Tycho Brahe's Head in Fleet Street in 1735. It is also known that he was making instruments for the East India Company in 1735-36. He obtained a world-wide reputation as a maker of Globes. In 1766 he published the first edition of his book, " A Treatise describing and explaining the construction and use of new celestial and terrestrial globes." Dr. Samuel Johnson the lexicographer, wrote the dedication to the King, and for so doing received a present of " very curious meteorological instruments of a new and ingenuous construction." The book had a great vogue, passing through thirty editions.

Adams was essentially a mechanic, and delighted in good workmanship. There can be little doubt, I think, that the microscope was his favourite instrument, and he developed several types of it. In 1746 he published his " Micrographia Illustrata: or The Knowledge of the Microscope explained in several New Inventions, etc." The preface to the " Micrographia Illustrata " emphasises the religious side of Adams' character, and also shows that he must have had the artistic and poetic temperament highly developed.

The first edition contained an account of a " New Universal Microscope," which was made to an entirely original design, the object being, as Adams states, " to have a Microscope which would be Portable and Universal that is to say, ONE ONLY INSTRUMENT, by which all Sorts of minute Objects might be observ'd." The microscope was provided with six single lenses of different foci with a common focussing screw. Adams remarked of this focussing screw that it " is to be turned as your hands and arms are resting on the table, which is a conveniency to be met with in no other Microscope." A second edition of the " Micrographia Illustrata " appeared in 1747, and a fourth in 1771. Despite exhaustive researches it has not been possible to find a copy of the third edition—if it were ever published.

The fourth edition commences with a description of the Variable Microscope, of which Adams was evidently very proud. He states that " we owe the construction of the Variable Microscope to the ingenuity and generosity of a noble person," and we know that the " noble person " was the Earl of Bute. By having a compound eye lens and by introducing an auxiliary lens placed some distance above the objective the definition was improved. Adams also introduced the method of screwing two or three objective lenses one on top of the other. By drawing up the eye-piece relative to the object glass the power of the combination could be altered, and hence the name " variable." Adams, in common with Martin and other makers of the period, developed the solar microscope with the large mirror projecting out of the window, by means of which brilliant illumination could be obtained, and magnified images of the object projected on to a screen.

The fourth edition of the " Micrographia Illustrata " is dated 1771, and Adams died in 1773. He must have lived a full life as, judging by the large number of instruments that may be found bearing his name, and by the " Catalogue of Mathematical, Philosophical and Optical Instruments " published in the end of the " Micrographia Illustrata," he must have had a large and flourishing business.

He left it to a son—George (born in 1750)—who added greatly to the prestige of the firm. He was a cultured man, and a favourite at Court. He wrote a large number of books, the majority of which passed through more than one edition. The most famous of his books was his "Essays on the Microscope," published in 1787. In the preface he states frankly that he had intended to confine himself to a re-publication of his father's work, the "Micrographia Illustrata," but that knowledge of the subject had increased so much since his father wrote, that he felt the book had to be re-written. Discussing the natural history side of the subject he states that he has endeavoured to correct some of the faults in arrangement, etc., "by arranging the subjects in systematic order, and by introducing the microscopic reader to the system of Linnæus, as far as it relates to insects." Chapter I. is an extremely interesting history of the microscope, as observed by one who lived close to many of the inventions. In it he mentions that he invented an improved form of the lucernal microscope in 1774. In Chapter III. he mentions that "this microscope was originally thought of, and in fact, executed by my father; I have, however, so improved and altered it, both in construction and form, as to render it altogether a different instrument." He also mentions that "the great demand I have had for them has fully repaid my pains and expenses (*sic*) in bringing it to its present state of perfection." The lucernal was a simple compact form of projection microscope which met with general approval as an instrument which could be conveniently demonstrated to a number of people at the same time.

A second and enlarged edition of the "Micrographia Illustrata" appeared in 1798, edited with great care by F. Kanmacher. This editor in a foot-note dwells on the fact that Adams had not given full credit to Benjamin Martin for what he had done to develop the microscope. Adams' "Geometrical and Graphical Essays," first published in 1790, was an extremely useful text book for surveyors, civilian and military. The lectures on "Natural and Experimental Philosophy," first published in 1794, in five volumes, very nearly cover the range of physics as then understood—or in the words of a sub-title, "describing in a familiar and easy manner the principal phenomena of nature, and showing that they all co-operate in displaying the *goodness, wisdom, and power of God.*" One is much impressed with the immense amount of work involved in the preparation of these books, for they are full of individuality. The Lectures were evidently written under difficulties. In the preface the author mentions, "During the composition of these Lectures I have had to attend to the grateful calls of daily business, and have struggled with much weakness and langour." He passed away on August 14th, 1795. We learn from an editorial note to the second edition of the "Essays on the Microscope," that Adams at the time of his death was preparing a new edition, and that he had other books in view. After his death his books and instruments were sold by auction, and the stock and copyright of his books were purchased by the brothers W. and S. Jones. William Jones was responsible for the editorial work and the re-publishing of several editions of Adams' books. The firm also continued to make instruments to the Adams' design for many years.

The manuscripts and plates of Adams the elder were inherited by his widow, who gave them to her younger son, Dudley. He edited a 30th Edition of the Treatise on the Globes, published in 1810. It is said that he intended to publish another edition of the "Micrographia Illustrata," but it is not improbable that the revised edition (1798) of his brother's "Essays on the Microscope" rendered this unnecessary. Dudley Adams appears to have continued in the instrument business, as Mr. Court possesses a statement written on the back of a shop print, about 1880, of the wholesale trade terms for telescopes. These were evidently of the short brass draw-tube type which Dudley Adams had developed. The note attached to the price list states that "the object glasses not being single but achromatic" shows that non-achromatic glasses were sometimes sold.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

The meeting this year will be held at Bristol from September 3rd to 10th, when some 300 papers will be submitted.

This year's President is Prof. O. Bower, Emeritus Professor of Botany in the Glasgow University.

The President's address this year will follow the modern rather than the older style. The model which passed in review the advancement made in every department of science will not be adopted by Professor Bower. His address will be purely botanical and will consist largely of a statement concerning his own work, and his subject will be "Size and Form in Plants."

It is interesting to note that at a meeting in Bristol in 1898 Sir William Crookes prophesied a world-scarcity of wheat unless agriculture sought the aid of chemistry. This year one of the subjects of the agricultural section will be the relation of nitrogegn to our food supply.

A meeting in Bristol is also a natural stimulus to the archæological, geological, and engineering interests. There will be lectures on Roman remains in Gloucestershire, and on geological formations such as those at Cheddar. Modern engineering has an important representative in the Bristol Aeroplane Company. There will be papers on recent progress in air-cooled aero-engine development and on the present position of the high-speed heavy oil engine. The latter will be associated with another lecture, by Lieutenant-Colonel V. C. Richmond, the designer of the airship R 101, which is driven by heavy oil engines.

Much attention will be given by the section of mathematical and physical sciences to wireless problems. A discussion on the meteorological relations of atmospherics will be shared by Dr. R. A. Watson-Watt, Professor E. V. Appleton, and Mr. M. A. Giblett. Professor Appleton will also read a paper on wireless echoes, and wireless demonstrations will be given by the B.B.C.. Town-planning will be fully discussed by the geography section, and the position of the British dyestuffs industry will be discussed in the chemistry section by Professor G. T. Morgan, Sir William Pope, Professor J. F. Thorpe, Professor A. G. Green, and others.

The public lectures will be numerous. Bath, Cheltenham, Gloucester, Devizes, and Chard, for instance, have all asked for lectures on economic subjects. Sir Josiah Stamp will lecture at Bath on the price level and scientific control. Weston-super-Mare having chosen a health subject, will hear Professor Winifred Cullis on "Breathing under difficulties"; Swindon will have a lecture on some branch of aeroplane engineering by Wing-Commander Cave-Brown-Cave, and Cirencester will have a description of Gloucestershire excavations by Dr. R. E. Mortimer Wheeler.

Sir Arthur Keith will speak on the contribution of Dr. John Beddoe, the Bristol anthropologist, to modern anthropology. East African archaeology and astronomy will be other subjects at Bristol.

The centenary meeting of the British Association will be held next year in London.

Forthcoming Events.

THE FARADAY SOCIETY.

A General Discussion on Colloid Science Applied to Biology is to be held in the Laboratory of Physical Chemistry, Cambridge, from 29 September to 1 October, 1930.

A number of workers in various branches of biological science have been invited to prepare reports on Physico-Chemical Problems, and especially those encountered in the Study of Living Matter, and to submit them for consideration by workers in Physical Chemistry, as well as by other Biologists. These reports will be circulated during the vacation in order that ample time may be allowed for the preparation of considered contributions to the discussion in Cambridge. A list of the Reports for discussion and the authors who have been invited to contribute them is given hereunder.

PROGRAMME.

I.—"Equilibrium in Protein Systems."—Monday, September 29: (In the chair: Sir William Hardy, F.R.S., who will introduce the Discussion).

Membrane-phenomena in Living Matter—Equilibrium or Steady State. By Professor A. V. Hill, F.R.S. (London).

The State of Water in Colloidal and Living Systems. By Dr. R. A. Gortner (Minnesota).

Distribution of Diffusible Ions in Gels. By *Professor E. J. Bigwood (Brussels)*.

The Behaviour of Proteins towards other *Colloids and towards Electrolytes. By* Professor W. Pauli (Vienna).

The Biological Significance of the Physical Influence of Gases on Colloids. By *Professor F. F. Nord (Berlin)*.

II.—"The Structure of Living Matter." —*Tuesday, September 30; Wednesday,* October 1. (In the chair : Sir F. Gowland *Hopkins, F.R.S.*).

The Structure, Behaviour and Physiological Characteristics of Vertebrate Cells cultivated *in Vitro*. By Dr. Honor B. Fell and Dr. Wilmer (Cambridge). Followed by Cinematograph Studies of Living Cells by Dr. Canti (London).

The Kinetics of Living Matter. By Professor E. Faure-Fremiet (Paris).

Surface Structure in the Integration of Cell Activity. By Professor R. A. Peters (Oxford).

Surface Reactions in Living Cells. By Dr. Hans Pfeiffer (Bremen.)

Double Refraction in Protein Systems. By Dr. A. von Muralt and Dr. J. Edsall (Harvard).

The Mechanism of Bacterial Action. By Dr. J. H. Quastel (Cambridge).

In addition to those whose names appear on the programme, the following indicated their intention to be present and take part in the Discussion :—Professors E. F. Buxton (Toronto); J. Duclaux (Paris); H. Euler (Stockholm); H. R. Kruyt (Utrecht); H. Lundegardh (Stockholm); W. J. Osterhaut (New York); Wo. Ostwald (Leipzig); Professor and Mme. Jean Roche (Lyon); Drs. P. Lecomte du Nouy (Paris); Straub (Amsterdam); T. Svedberg (Upsala).

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

2,550.—I. G. Farbenindustrie Akt.—Ges.— Manufacture of dyestuffs. July 16.

2,680.—I. G. Farbenindustrie Akt.—Ges.— Manufacture of aminodiazoanthra-

21,818.—(I. G. Farbenindustrie Akt.—Ges.) —*Manufacture of compounds* containing nitrogen. July 18.

Specifications Published.

332,122.—(I. G. Farbenindustrie Akt.—Ges.).—Manufacture of naphthalene—2 :3—dicarboxylic acid.

Abstract Published.

330,026.—Acetic acid. Soc. Anon, Des Distilleries Deux-Sevres, Melle, Deux-Sevres, France.

Crude pyroligneous acid or its vapour is treated first with the quantity of a solvent necessary for the removal of tar, and the purified acid is then treated with the quantity of the same solvent necessary to extract the acetic acid. Preferably the solvent is so chosen that at least twice as much is necessary for the second treatment as for the first, and the proportion may be much higher; for instance the ratio is 16 :1 in the case of amylacetate. The solvents mentioned are acetic esters, aliphatic ketones such as cyclohexanone and methyl cyclohexanone; and mixtures of these solvents may be employed. Pressures other than atmospheric may be employed for the whole or a part of the process.

Printed copies of the full published specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2., at the uniform price of 1/- each.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

EPHRELIX.

513,751.—Chemical substances prepared for use in medicine and pharmacy. Evans, Sons, Lescher and Webb, Ltd.—56, Hanover Street, Liverpool, Lancashire. July 23. (Associated).

EPHRETUSS.

513,753.—Chemical substances prepared for use in medicine and pharmacy. Evans, Sons, Lescher and Webb, Limited, 56, Hanover Street, Liverpool, Lancashire. July 23. (Asso-

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NOTICE TO AUTHORS & CORRESPONDENTS

Contributions for publication either as original articles or in the correspondence columns are welcomed by the Editor of *The Chemical News.*

They must be accompanied by the contributors' full names and addresses, not necessarily for publication, but as an indication of good faith. If a reply is needed or if it is desired that a manuscript which is not accepted for publication be returned, a stamped addressed envelope should be enclosed.

No notice can be taken of anonymous letters.

THE METAL CRYSTAL.

By SIR HAROLD CARPENTER, M.A., Ph.D. F.R.S.

(*Royal Institution of Great Britain, Friday, May 20, Sir Robert Robertson, K.B.E., D.Sc., LL.D., F.R.S., Treasurer and Vice-President, in the Chair.*)

When prepared by one of the usual methods, metals and alloys consist of an aggregate of small allotrimorphic crystals. Pure metals usually consist of a large number of similar crystals. Alloys are sometimes composed of one type of crystal, though usually they contain two or more different kinds. In both cases metals, as ordinarily prepared, contain anything from about one hundred thousand to several millions of crystals per cubic inch. In all metals, however, the individual crystal is the unit of which the aggregate is built. It is therefore the simplest form of metal.

The size and shape of the crystal depends on the type of mould in which the fluid metal is cast, and on the rate of cooling, and in any given casting crystals of various types may be obtained. In the casting of a steel ingot, *e.g.*, a lay of "chill" crystals forms in contact with the surface of the mould. Attached to these columnar crystals grow nearly at right angles to the surface, while in the interior equiaxed crystals result, which are due to the separation of minute crystals in the liquid which grow and form interference boundaries. In addition to these skeleton crystals grow on the surface, and sometimes also in the cavity produced by shrinkage in the upper part of the ingot. During the subsequent mechanical treatment to which the metal is subjected, these crystals change, their shape. If the mechanical work is severe they are fragmented, and eventually complete re-crystallisation takes place with the birth of new crystals. Whether, therefore, a given metal or alloy is used either as a casting or in some worked form, it always consists of an aggregate of crystals.

The properties accordingly of metals and alloys in the ordinary state are the properties of these *aggregates.* In other words, they are composite. As already mentioned, the individual crystal is the unit of which these aggregates are composed. Even if it possessed directional properties, these would not be revealed by any tests on polycrystalline material, since the individual crystals are oriented in many directions, and the properties would be cancelled

out. In addition to this, however, the properties of the crystal boundaries themselves have to be considered. The finer the aggregate the larger the area occupied by the boundaries. It has long been known that the boundaries in a crystal aggregate are stronger than the interiors of the crystals. A metal, *e.g.*, fractures under tensile test through and not round the crystals. One of the commonest methods of increasing the strength of a metal or alloy is to diminish its crystal size and increase its boundary area by suitable thermal and mechanical treatment. The properties of any given metal, therefore, are the resultant of those of the very numerous individual crystals of which it is composed, oriented in many positions, modified by the properties of the crystal boundaries.

If it were possible to study the properties of the individual metal crystal the variables which have just been mentioned would be excluded, and the observations made would be of fundamental scientific value. Any particular property of the metal crystal itself could be studied, the only variable being its orientation. It would thus enable the test to be made whether the property in question was directional. From a scientific standpoint, therefore, the study of individual metal crystals should precede that of aggregates. Owing to the fact, however, that special conditions have to be observed if a metal is to be obtained in the form of a single crystal, the order of investigation has in practice been just the opposite.

It is the realisation of this fact which gave rise, about twelve years ago, to definite attempts on the part of investigators to prepare single metal crystals. Considering its great scientific importance it is perhaps surprising that the attempt was not made earlier, but it is clear that it could not have been made with any real prospect of success until the technique of mettalographic research had reached the necessary stage of perfection.

Looking at the problem of preparing a given piece of metal in the form of a single crystal, it is theoretically capable of solution in at least three different ways :—

(1) By production of the crystal from the vapour phase.
(2) By its production from the liquid phase.
(3) By the conversion of the solid metal in the ordinary poly-crystalline aggregate into a single crystal.

Success has been achieved in each of these ways. To-day there are nine methods of producing single metal crystals—two from the vapour, three from the liquid, and four from the solid phase. Each of these is an example of what may be called *controlled* crystallisation, and the investigation of any particular metal divides itself into three parts :—(*a*) the production of the crystal itself, (*b*) the determination of its orientation, and (*c*) the study of its properties. The last category may be divided into two sub-categories, according as the investigation either (1) does, or (2) does not involve the distortion of the crystal. I propose to consider, in so far as time permits, something of each of these aspects of the subject.

Production of Single Crystals from the Vapour Phase.—Two methods are available, each of which is based upon the technique developed in the incandescent lamp industry for depositing tungsten metal on a glowing wire. The one is due to Koref[1], the other to Van Arkel[2]. Both methods start with a single crystal obtained by another method. This serves as a nucleus and grows to a large single crystal. As an example the production of single crystals of zirconium, by J. H. de Boer and J. D. Fast[3] may be described. There is a special interest about this method in that not merely has it enabled this metal to be produced in the monocrystalline form, but also that it has for the first time led to its production in the pure state in which, whether mono- or poly-crystalline, it is ductile, whereas as previously prepared it has always been found to be brittle. This is now known to be due to small traces of impurities.

The principle of the method is the deposition on a glowing metal filament of the metal in question by the thermal dissociation of a volatile compound. The essential condition for success is that below the melting point of the metal to be prepared a temperature range must exist, in which the vapour pressure of the metal is smaller than the partial pressure of the metal in the vapour phase. In this particular case the metal filament consisted of tungsten, and the compound in question was zirconium iodide. It is not necessary to prepare the iodide at the outset. A mixture of zirconium and iodide will do equally well. The tungsten filament, whose diameter is about 40μ, is heated by an electric current to a black-body temperature of 180° C., as read by an optical pyrometer. The reaction vessel made of pyrex glass is then placed in an electric furnace and heated to about 600° C., The zirconium powder and iodine combine to form the iodide, and this com-

pound then sublimes. It is decomposed by the filament at 1800° C., and the zirconium deposited on it. Free iodine is then available to combine with a fresh quantity of zirconium in the reaction vessel, and the cycle of changes is repeated until sufficient metal has been deposited. The filament is cooled by the solidification of the zirconium, and from now on the temperature has to be measured through the strongly coloured vapours of iodine and the iodide. The success of the experiment depends upon depositing zirconium at the correct temperature. This has been found to be about 1800° C. The current rises from an initial value of 0.25 of an ampere for a filament of 40μ to 200 amperes when the metal has grown to a diameter of 5 mms. Whether the temperature of the filament falls or rises during the experiment depends upon the external resistance. If this is small the strength of the current is determined by the filament itself. As this grows its resistance falls in proportion to the square of the diameter, whereas cooling by radiation is proportional to the diameter. Therefore, the temperature of the filament tends to rise, and this must be prevented by increasing the external resistance. Conversely, if the external resistance is large this determines the current, and the zirconium rod, which is continually becoming thicker, tends to cool.

If the temperature of the filament is kept at 1700° C. the zirconium deposited is polycrystalline. Between 1750° and 1850° C. the crystals of zirconium are so large that only one occurs in the cross-section of the wire, and the built-up rod consists of a series of single crystals of from 0.5 to 1.5 cms. long build round the tungsten nucleus. The crystals thus formed are found to be hexagonal prisms. If the temperature is allowed to rise to 1900° C. the zirconium grows very rapidly at first, but before long it reacts with the tungsten filament and forms a eutectic.

This method is suitable for preparing single crystals of the high-melting lamp filament metals. Van Arkel and De Boer have applied it to titanium, hafnium and thorium. Koref, in co-operation with Fischvoigt[4], has succeeded in preparing single crystals of molybdenum, tantalum, iron, zirconium and tintanum by his method. It is possible, therefore, by either of these methods to prepare single crystal wires and thin rods of high-melting metals, the vapour of whose compound with iodine satisfies the condition described above.

Production of Single Crystals from the Liquid Phase.—Brief mention may be made of two of the methods available. These have been mainly used for preparing single crystals of low-melting metals in refractory glass containers, but they can also be applied to metals and alloys of higher melting points in suitable containers.

The first method is that devised by Czochralski[5], who prepared long thin threads of crystals by drawing them out at a particular rate from the molten metal contained in a crucible just above the freezing temperature. The metal is drawn upwards by means of an auxiliary wire moving vertically at a uniform rate. At some mms. above the surface of the molten metal solidification begins. The rate of movement of the auxiliary wire has to be the same as the speed of crystallisation. If it is too quick, the single crystal wire breaks; if too slow, poly-crystalline wires are produced. In this way single crystal wires (0.5 mms. diameter) of tin, lead, and antimony have been prepared. This method was developed further by Gompers (1922), and Mark, Polanyi and Schmit (1923).

Single crystal rods up to one inch in diameter can be grown by the second modification due to the work of Tammann (1923), Obreimow and Schubnikow (1924), and Bridgman (1923-25). In Bridgman's method the molten metal contained in a suitable closed tube of refractory glass or quartz is slowly lowered through a tubular electric furnace in a vertical position, kept at a temperature somewhat above the melting point of the metal in question. The lower end is tapered to a point which is the first to emerge from the furnace. Solidification starts here and proceeds slowly upwards. Provided the rate of lowering is less than the velocity of crystallisation and sufficient slow for the latent heat of solidification to be dissipated by conduction, the metal usually crystallises as a single crystal, and in this way Bridgman prepared single crystal bars of tin, cadmium, zinc, antimony, bismuth and tellurium.

This method depends for its success upon the formation of only one nucleus, upon which the subsequent solidifying metal crystallises uniformly. If, however, crystallisation starts from more than one centre, then some means must be found of confining the growth to one crystal. The best way to meet this difficulty was found by drawing the lower part of the tube out into a separate chamber separated from the main part by a capillary 0,1 mm. in diameter.

This acts as a filter and allows only one of the several crystals which may have formed initially in the lower bulb to get through into the main part of the tube. It is this crystal which then grows and forms the single-crystal test-piece. Bridgman's experiments were carried out by allowing the crystal to form in vacuo, and the elimination of all dissolved gas is therefore an essential condition of the success of this method. The rate of lowering depends both on the metal and the size of the tube. In the case of bars 2.2 cms. diameter a speed of about 4 mms. an hour was found to be suitable. For bars of small diameter, however, speeds up to 60 cms. per hour could be employed.

The removal of the single crystal bar from the tube is an operation requiring great care. If the containing vessel is perfectly clean the metal sticks and cannot be removed without distortion. The tube must therefore be greased. A convenient way to do this is to flush out with a heavy mineral oil and then wash this out with petroleum ether. The tube is then heated so as to remove the ether, but a thin film of oil clings to the glass and is sufficient to prevent the metal from sticking.

Davey[6] modified Bridgman's method by using a graphite tube, and succeeded in making single crystal copper test-pieces six inches long and nearly one inch in diameter. Miss Tlam[7] has shown that single crystals of copper, silver and gold can be grown in graphite tubes in an atmosphere of nitrogen. This has proved to be an advantage since when grown in this way the metals are quite sound, whereas if melting is carried out in vacuo there is a liability for the resulting rod to contain blow-holes. Here also the greatest care is required in removing the crystals, particularly of soft metals, from the containing tube. On one occasion it was found on removing a single-crystal rod of gold that it was twisted into a spiral showing three complete turns.

Production of Single Crystals from the Solid Phase.—The problem here consists in the conversion of a poly-crystalline into a mono-crystalline metal. Success has been reached in this case by the utilisation of an observation made by Sauveur[8] in 1912. He showed by carefully straining and subsequently heating certain metals that crystals of a larger size could be produced and suggested that there was a *critical stress* which produced the largest crystals. Subsequently Ruder[9], Chappell[10], Jeffries[11], and Hanson[12] have shown that if a metal is locally de-[illegible]d and then heated exceptionally large crystals form at some distance from the point at which the stress is severest. If a tapered test-piece is used a strain gradient is obtained, and the largest crystals always form within the strained region, but further from the area of greatest strain the higher the temperature. Seligman and Williams[13] stretched aluminium sheet which had previously been heated to various degrees, and found on heating that up to a certain point a small deformation had no effect. Beyond this point, however, large crystals were formed, and as the deformation was further increased the crystal size was diminished. The crystals produced by these methods were very large compared with those in the original metal, some of them being 0.5 inch long.

Single crystal test-pieces were first produced from the polycrystalline metal in the case of aluminium by the following series of treatments[14]: (1) the metal has first to be softened completely, recrystallised and converted into new equiaxed crystals of as far as possible uniform size. The most suitable size has been found to be 36 per square millimetre. This condition was produced by heating the metal for six hours at 550° C. (2) These crystals must then be strained to the required amount. The precise degree of strain for the aluminium used was an elongation of 1.6 per cent. on three inches, produced by a tensile stress of 2.4 tons per square inch. (3) The strained crystals have afterwards to be heated in such a way that the potentiality of growth conferred by strain can be brought fully into operation. This final heat treatment was begun at 450° C., and the temperature raised about 25° C. per day up to 550° C. It was finally raised to 600° C. for one hour in order to complete the absorption of small crystals on the surface which persistently remained at lower temperatures.

The boundary of the single crystal thus produced extends at each end in the form of an irregular surface into the head of the test-piece, and by this means single crystal bars of aluminium have been prepared whose diameter was 0.564 inch, and length about 8 inches. Polycrystalline bars 0.798 inch in diameter have been converted into single crystals over a length of 4 inches. In this way upwards of seven million of the original crystals can be caused to coalesce into a single crystal. How delicate the process of adjustment of strain is may be judged from the fact that its precise value has to be determined for each fresh batch of aluminium, even though the metal is of the same "works" composition. On an aver-

age one experiment in four succeeds in producing a single crystal test-piece. To give one illustration, the result of treating a batch of twenty polycrystalline test-pieces was that seven were converted into one crystal, eight into two crystals, four into three crystals, and one into four crystals. This method has been successfully applied by Edwards and Pfeil[15] to the production of large crystals of iron. It has also been utilised by Miss Elam[16] in the production of single crystals of solid solution alloys of zinc in aluminium. Schaller and Orbig have used it to prepare single crystal wires of tungsten and molybdenum, while Altertum has prepared single crystal bars of tungsten by making use of the peculiar effect steam has on small tungsten crystals at high temperatures.

The production of single crystal test-pieces from polycrystalline metals by the method of critical straining, followed by heating, is a more complex process than that of the preparation of single crystals direct from the vapour or the liquid.

The deformation of a metal is possible on account of the existence of "atomic planes" present in each crystal. These are planes which can glide and slip along each other. In a *single crystal bar* where the orientation is uniform these planes function unhindered. In a *polycrystalline bar*, however, where the crystals are variously oriented the movements are quite different. The first crystals to yield are those so oriented that they display the least resistance to stress. The degree of this is limited since they are held in a rigid matrix of other crystals. Hardening takes place along the slip planes and the movement is finally arrested. Limited slip then takes place on other crystals which now present the least resistance to the stress, and they in their turn are hardened. The process is then repeated in other crystals. The net result is that in this case the planes of slip are not uniform but bent. According to van Liempt[17] "in this way strains are produced in the crystal because the original distance of the atoms has not remained quite the same and the electron lattice has been distorted. The deformed metal now is in a labile condition. The lability is locally the greater as the strain increases. If the deformed metal now is brought to a high temperature there will be an inclination to return to the stable condition."

The method of critical straining consists in straining the crystals of an aggregate in such a way that when it is heated only one of the crystals recrystallises and forms a nucleus. On continuing the heating the remainder of the crystals which are in a labile condition gradually recrystallise and align themselves on the single nucleus. Ultimately, therefore, a single-crystal bar is obtained. If, however, the bar were heated at a higher temperature, a number of strained crystals would recrystallise forming nuclei, and each of these would act as a crystallisation centre. The result would be a bar containing as many crystals as there were nuclei. The reason why in any given set of experiments only some of the bars become monocrystalline is that it is not always possible to ensure that only one labile crystal recrystallises in the first instance. This method in fact permits crystals of any desired average size to be grown from a polycrystalline aggregate, since it is only necessary to adjust the degree of strain and the temperature to the requisite condition. In this respect it is the most general of the methods available for preparing large crystals. Moreover, it is quite independent of the melting point of the metal or alloy. In another sense, however, it is more restricted, since it depends on the response of the crystal lattice to stress and the liability of the metal or alloy to form twin crystals on being heated. If such liability exists single crystals cannot be prepared by this method.

THE ORIENTATION OF THE CRYSTALS IN SINGLE TEST-PIECES.

The only satisfactory method of determining the orientation of the crystals is by X-ray analysis. The original method of determining the crystal axes was worked out by Müller[18]. It involves the preparation of bars of square section and the photographing of the reflections from the crystal planes. A special arrangement is required for mounting the bar so that it can be rotated on a vertical axis and photographed in the desired positions. He found that the reflections from unstrained bars are perfectly clear and sharp, and are obtained within a narrow setting angle, whereas, if the bars are strained the reflections become "fuzzy," and are spread over a wider setting angle whose width increases with the extent of the distortion. In Müller's method the data can only be obtained for a very thin surface layer of the test-piece. The measurements which he made, however, on the various parts of the surface showed that this layer had the same orientation relative to the reference plane over the whole surface. It seems probable, therefore, that the same thing holds for the entire rod.

I will now deal briefly with two questions to which the method of X-ray analysis gives definite answers :— (1) Are the single crystals obtained in the various ways I have described perfect crystals in the sense that the orientation of their atoms is uniform, corresponding to the crystal symmetry, and are they free from strain? It will of course be realised that owing to their method of preparation they cannot, with one exception, possess the external forms, but only the internal symmetry of crystals. The particular exception to which I refer is the case in which they have been produced from vapour, and here ,provided suitable conditions are maintained the crystal wires do show the external forms of crystals. So far as they have been tested, single crystal rods and wires, prepared either from the vapour or the liquid phase, show themselves perfect crystals when tested by X-ray analysis. This is very much what is to be expected, at any rate in the latter case, since the crystals have been deposited from the liquid by slow cooling under conditions in which no strain should be produced. But it is interesting that the reactions obtained from aluminium single-crystal test-pieces, grown from the polycrystalline solid by the method of critical straining and heating, are also perfectly sharp, and indicate the complete absence of strain, at any rate as far as the external layers of the crystals are concerned. It follows from this that the small strain set up in their production is completely removed by the prolonged heat-treatment to which they are exposed. This conclusion is supported by the fact that when such bars are slightly distorted the X-ray reflections immediately become less clear.

(2) Do the crystals grow more easily in certain positions than in others, *i.e.*, do they take up a preferential orientation? As yet no evidence is available on crystals deposited from the vapour phase. Bridgman concluded that the favoured position of growth from the liquid is that in which the principal cleavage plane is parallel to the axis of the crystal, and has stated that in the case of large crystals of antimony no specimens were found which were oriented in any other way. This, however, does not fix its orientation, since this plane of cleavage may have any orientation within 180° about the axis of the casting. Miss Elam has shown that in the case of rods of copper, silver, and gold, grown from the liquid, there is no particularly favoured position. Considerable variations of position have been found by her in the case of crystals grown by the method of strain and heat-treatment, and the evidence on this point is now quite extensive.[19] Twenty-nine aluminium, twelve aluminium-zinc alloy, and ten iron single-crystal test-pieces have had their orientations determined. In the case of aluminium a great variety of orientations was met with, since the position of the axes were found to be scattered over a wide field, but the majority of the crystals favoured a position near the (110) axis, and none have yet been obtained near either the (111) or the (100) axis. Moreover, this was also found to be the case for an aluminium test-piece consisting of four crystals. In the aluminium-zinc alloy a considerable variety of orientations was also found, but here it was the (110) axis which was avoided. Five out of twelve crystals were found to be near the (100) axis. In the case of iron a wide range of positions was found among the ten crystals. The (110) axis was avoided, but no evidence was found of any preferential orientation. Summing the evidence up it is clear that in the case of the fifty-one crystals whose positions have been thus determined, the method of straining and heat-treatment does not determine to any marked extent the orientation of the crystals which grow, although certain orientations are avoided. Growth appears to be equally easy in a great variety of positions. The orientations which are avoided are no doubt those in which growth is more difficult. The problem of growing a single-crystal test-piece in a measured orientation has been recently taken up and a certain measure of success has been obtained.[20]

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(*To be continued.*)

SEVENTY YEARS AGO.

(From the Chemical News, Dec. 31, 1859.)

BARON LIEBIG ON THE SEWAGE MANURE QUESTION.

A letter from Baron Liebig to Mr. Mechi, on the subject of sewage manure, has been published in the *Times*. Mr. Mechi, in a letter to the *Times*, a short time ago, insisted on the great importance of the subject to England, and the Baron takes up the matter in support of Mr. Mechi's views :— "It is my ardent wish," he says, "that you may succeed in awakening the English people to your own convictions; for in that case the ways and means for setting aside the difficulties which stand in the way of procuring manure from the sewage of towns will certainly be found, and a future generation will look upon those men who devoted their energies to the attainment of this end as the greatest benefactors of their country."

The Baron goes on to remark on the constant diminution of productiveness in a soil, occasioned by the loss of those elements which are indispensable to the reproduction of the crops :— "The loss of these elements is brought about by the sewerage system of towns. Of all the elements of the field, which in their products in the shape of corn and meat, are carried into the cities and there consumed, nothing, or as good as nothing, returns to the field. It is clear that if these elements were collected without loss, and every year restored to the fields, these would then retain the power to furnish every year to the cities the same quantity of corn and meat; and it is equally clear that if the fields do not receive back these elements, agriculture must gradually cease."

He then combats the opinion that England will always be able to exchange her coal and iron for corn :— "The time may perhaps come, even in half a century, that not one of those countries upon whose excess England has hitherto drawn will be able to supply her with corn; and that too from the natural law that what is true of the smallest piece of ground is true also of a great country. It ceases to produce corn, if the conditions of the reproduction of the corn which has been carried off are not restored to it. Nor is it, furthermore, certain whether the corn-growing countries will always desire to exchange their corn for the products of English industry, since they may no longer need these products, or at least in the ratio of England's need of corn. History teaches that not one of all those countries which have produced corn for other lands have remained corn markets; and England has contributed her full share towards rendering unproductive the best lands of the United States, precisely as old Rome robbed Sardinia, Sicily, and the rich lands of the African coast of their fertility. Finally, it is impossible in civilised countries to raise the corn production beyond a certain limit, and this limit has become so narrow that our fields are no longer capable of a higher yield, without an increase of their effective elements by the introduction of manures from abroad."

BITUMINOUS SANDS OF ALBERTA.

As the result of experiments which have been conducted recently, it has been established that bitumen from Alberta tar sands, hydrogenated at high temperatures and pressures, will form a light crude oil amounting under favourable conditions to 80 per cent. or more of the original bitumen. It is believed that this yield can be increased by the use of more efficient apparatus. The optimum temperature was in the region of 380 degrees C., and the best catalysts used were ammonium molybdate and aluminium chloride. An absorption of hydrogen equivalent to 3 per cent. by weight of bitumen was easily attained. The oil had a sulphur content equal to about one-half that of the bitumen: it is easily refined to produce a stable white gasoline.

A copy of the journal in question can be consulted by persons interested at the Canadian Building, Trafalgar Square, London, S.W.1.

ON THE HYGROSCOPICITY OF UREA.

By Sojiro Oka.

Among many nitrogenous fertilisers, urea is said to be one of the most hygroscopic. The author made several experiments with a view to improve this point without making any detrimental effect upon its fertilising quality.

The test of hygroscopicity was done usually by the moist air flow method. The weighed sample put in a U-tube was subjected to the flowing air of definite moisture content, and the weight increase was measured at definite interval of time. Sometimes the comparisons were made in the stationary air; the samples to be compared were placed in a glass vessel containing sulphuric acid or water at the bottom, and subjected to moisture absorption.

(1) It is easily conceivable that the hygroscopicity may be reduced by pressing powdered urea into a cake. In the author's test in the stationary air, the hygroscopicity of pressed urea, 1 gram in the form of a cylinder 1 cm. high, 1 cm. diameter was found to be about 75 per cent. of that of the powdered urea.

(2) The trials to convert the surface of the pressed urea into the non-hygroscopic urea nitrate were not successful.

(3) The urea containing 10 per cent. water was melted and poured on the cold plate. The hygroscopicity of this product was much less than the above. It was possible to improve it further by casting the molten urea containing 10 per cent. of water in a cold copper tube cooled by ice.

(4) The urea without any water was similarly treated, namely, it was just melted at about 140° C. and rapidly cooled by casting in the copper tube. The hygroscopicity of this product was still less.

The samples obtained by the last method were tested by the stationary air method at 20° C., the four different humidity being used to represent the average humidity in the four seasons in Japan. The results indicated that in the humidity below 14 mm. the samples were almost non-hydroscopic at 20° c., but in humidity above of this value absorb moisture very rapidly.

Let W be the amount of moisture absorbed by a definite amount of urea cake at a certain time t of exposure to the moist air and P be the aqueous vapour pressure of the air, the experiments indicate the following relation : $W = \text{const}\ (P - A)$, where A was a constant independent of t and P, and was found equal to 14mm., namely the aqueous vapour pressure of the saturated urea solution. This relation can easily be expected theoretically.

After these considerations, the author concluded that, in Japan, urea absorbs moisture only in summer season, namely, June, July, August and September, but in the other seasons it is not hygroscopic.—*Tokyo Imperial Industrial Laboratory.*

FARADAY CELEBRATIONS, 1931.

Faraday at the Royal Institution.

In 1831 Michael Faraday began, or rather resumed in his Laboratory at the Royal Institution, experiments on the induction of electric currents; and on August 29, 1831, made the discovery in which lies the origin of the dynamo and starting point of the utilisation of electric power for the purposes of man. On that day, as his Diary shows, he wound two coils of wire on to opposite sides of a soft iron ring, connected one coil to a battery and the other to a galvanometer, and at "make" and "break" of the battery circuit observed deflections of the galvanometer connected in the other circuit. From this simple experiment, and the variations of it made by Faraday in succeeding trials, have grown in the past hundred years the science of electrical engineering and the great electrical industry in all its phases as we know it to-day. No other experiment in physical science has been more fruitful in benefit for mankind. August, 29, 1931, is then the centenary of one of the great events in the history of the world.

It is fitting that the lead should be taken by the Royal Institution in the arrangement of the celebrations, for it was to the House of the Institution in Albemarle Street that Faraday came in 1813, a youth of twenty-two, to become assistant to Sir Humphry Davy, who was then the Professor of Chemistry; where later he succeeded Davy, and where he lived and worked and gave his famous lectures throughout his active life. Faraday took up the work begun by Davy, and established in the Institution the tradition of scientific research and exposition of the highest type which has been followed in it down to the present day.

It is no less fitting that the Royal Institution should have, in the arrangements for 1931, the assistance of the Institution of Electrical Engineers, the body representing

in this country the profession and industry which owe their existence largely to Faraday's great discovery. The two institutions have therefore joined forced in making the plans, and they are indebted to a number of other societies and organisations for their courtesy and co-operation. The Royal Society will entertain the delegates to the Celebrations; the British Association for the Advancement of Science has arranged the dates for its Centenary meeting in London, also in 1931, in consultation with the Joint Committee for the Faraday Celebrations; the Federal Council for Chemistry will participate in the arrangement of the Faraday Exhibition, for Faraday's chemical researches, his isolation of benzene and his establishment of the laws of electrochemistry, are hardly less remarkable than his purely electrical discoveries. Government, university and scientific interests have joined in offering their co-operation and assistance to make the celebrations worthy of the occasion.

Centenary Celebrations.

Provisional Programme and Dates.

The following programme has received the provisional approval of the Managers of the Royal Institution and of the Council of the Institution of Electrical Engineers:

Monday, September 21, 1931.

Afternoon: Reception of Delegates in the Lecture Theatre of the Royal Institution. It is hoped to invite representative institutions throughout the world to send delegates to the Celebrations.

Evening: Faraday Commemorative Meeting at the Queen's Hall, at which addresses will be given on Faraday's work.

Tuesday, September 22.

Morning: Summer Meeting of the Institution of Electrical Engineers begins, with Joint Conference of the Institution and allied Associations.

Afternoon: Visits and Social Functions.

Evening: Royal Institution: Conversazione at the House of the Institution.

Institution of Electrical Engineers: Conversazione and Faraday Exhibition at the Albert Hall.

Wednesday, September 23.

Morning: Opening of the Faraday Exhibition to the public. I.E.E. Summer Meeting and Conference continues.

Evening: Opening Meeting of the British Association at the Central Hall, Westminster.

Faraday Exhibition.

The principal responsibility for the arrangement of the Faraday Exhibition has been undertaken by the Institution of Electrical engineers. The central feature of the Exhibition, which will be held at the Royal Albert Hall, and will be open to the public for a period of about ten days from September 23, will be reproductions and illustrations of Faraday's actual experiments, prepared by the Royal Institution, and including a display of some of the historic apparatus. The Institution of Electrical Engineers, the Federal Council for Chemistry, and the representative organisations of the electrical and chemical industries co-operating with them, have undertaken to illustrate by means of special exhibits the full development of electrical and chemical science and industry in all branches which have their origin in Faraday's work. Thus will be demonstrated in an unique manner the full fruition of the work of one of the world's greatest natural philosophers.

Preliminary conversations with the British Broadcasting Corporation have taken place, and it is expected that arrangements will be made to broadcast the Commemorative Meeting at the Queen's Hall.

Publication of the Diary.

Throughout his life Faraday kept a careful Diary, in his own hand, of all his experimental work. On his death these "Experimental Notes" were bequeathed to the Royal Institution, and for over sixty years have been its most treasured possession. Although the philosopher himself made extensive use of it in the preparation of his published works, the Diary itself has never been published, and to mark the forthcoming Centenary the Managers of the Royal Institution have resolved to publish it in full. The work is now in course of preparation. It will be issued on behalf of the Institution by Messrs. G. Bell & Sons, Ltd., York House Portugal Street, London, W.C.2. It is intended to have two or more of the six or eight volumes in which the work will ultimately be completed ready by September, 1931.

Other Publications.

The preparation of a souvenir of the Celebrations is under consideration, and this may contain excerpts and facsimile pages of important passages from the Diary. It is hoped also to issue the addresses at the Commemorative Meeting in printed form; and to publish a Catalogue and description of the Faraday Exhibition.

ASSOCIATION OF BRITISH CHEMICAL MANUFACTURERS.

(*Continued from page 87.*)

To summarise, we are provding as new services, a montnly Summary of Chemical Trade, Safety Circulars, a Safety Summary, more Statistics and increased enquiry facilities. All of these naturally mean extra expense as the Treasurer will tell you; there has been practically no increase in our income, and while that income is being spent to the full, the extra services could not have been provided without the most careful economy in every direction. Furthermore, you all know the difficulties in launching new ventures, and I feel sure you will agree that we owe a great deal to our Staff for the initiative, energy and painstaking endeavour which has been given to the work of the Association. This is all the more praiseworthy when it is known that the work of the four other Associations for which they have to provide the secretarial and other services, have all increased in a similar manner. I feel sure that the knowledge that their services are appreciated will be an incentive to continued effort.

In conclusion I wish to take this opportunity of expressing my sincere thanks to all my colleagues on the Council whose willing help has done much to make my task an easy one. In particular I wish to express my gratitude to Dr. Armstrong and Mr. Hill for having taken my place as chairman on the numerous occasions on which I have had to be away owing either to illness or to business visits abroad."

After Mr. C. A. Hill had seconded the adoption of the report, and the Honorary Treasurer (Mr. E. V. Evans) had made a statement with regard to the Accounts, a general discussion followed.

Dr. E. F. Armstrong commented on the reception which the Report of the Patents Committee had received in the press, and complimented the Committee for having dealt with the very difficult problem of medical patents—surrounded as it was by medical etiquette—on tactful and constructive lines. Though their proposals have not gone as far as the critics would have liked, he felt that they would lead to useful results.

He referred, in terms of sympathy, to the serious accident at the works of Messrs. Hickson & Partners, Ltd., and to the great zeal which Mr. Bernard Hickson, the Managing Director, had shown on the Works Technical Committee in the study and application of safety measures in the chemical industry; he could think of no firm in which the Partners had taken greater care to ensure safety regulations, and he emphasised the opinion that what had happened had been due to causes which were outside any preventive measures which an employer can normally take.

He expressed his disappointment that the present Government had not shown themselves as receptive to science as was originally hoped; as a consequence, legislation had proceeded along well-known lines and there had been no attempt to solve the very grave problem of the day from the point of view of enlightened scientific progress, using the word scientific in both its technical and theoretical aspects; until this was done little progress would be made.

Dealing with the future, he referred to the very important steps which had been taken in connection with chemical standardisation and to the enthusiastic reception which had been given by the various bodies interested in chemistry to the Associations invitation to a Conference. He assured the meeting that in drawing up a scheme of organisation in connection with the British Engineering Standards Association, full automony would be secured for the chemical interests, and that nothing in the way of hasty standardisation would be attempted.

He also referred to the recent activites of the big oil companies which are tending more and more to brng them into the chemical industry; party through the appplication of hydrogenation to their crude oils, they now have in their cracked gases and certain oil products, raw materials of every great potential value for the manufacture of synthetic organic chemicals. He indicated the need for the clear visualisation of these possibilities, and for the close co-operation of the oil interests with the Association in the even of their embarking on a chemical manufacturing programme.

He concluded by congratulating the Chairman on his most successful term of office and the enormous amount of progress that had been achieved during that time.

Dr. F. L. Pyman (Messrs. Boots Pure Drug Co., Ltd.) while explaining that he had been one of the first to criticise the proposals of the Patents Committee in regard to medical patents, expressed his great appreciation of the enormous amount of work which the Committee had done.

Rt. Hon. J. W. Wilson (Messrs. Albright & Wilson, Ltd.) stressed the need for fresh efforts to solve the problem so that we might produce from it the spirit we need instead of

buying it from abroad. What an enormous economic change that would make. We used to boast that we sold enough coal abroad to pay for all tne corn that came in. Now we cannot sell enough coal to pay for the petrol we import. A solution of the oil from coal problem would enable this country to return to the position it boasted a century ago.

Mr. R. G. Perry suggested that tne time had come when the Council might turn to the consideration of its affairs in relation to the policy of the Government. He referred to the manifesto that had recently been issued by a number of great Bankers, and expressed the view that the producers of the wealth which the Banks handle so to express. He was not asking the meeting to pass any resolution, but merely, if they wished, to send a message to the new Council which would be sitting that afternoon, to suggest that it should consider the Bankers' manifesto. We cannot get away from the facts; unemployment to live without work; and to some extent we are living on our capital. A day of reckoning is bound to come. The situation is bad enough to require help from every side. We as producer ought to see if we can help.

Mr. F. W. Bain (Imperial Chemical Industries, Ltd.) referred, in connection with Mr. Perry's proposal, to the meeting of the Grand Council of the Federation of British Industries on the previous day at which a Resolution was passed unanimously, the purport of which was that a special Committee composed of the President and Past Presidents of the Federation be appointed to take such steps as they thought best to ascertain the views of the members of the Federation on the points suggested by Mr. Perry. The Association, as members of the Federation, should therefore take the first possible opportunity of dealing with the questionnaire which will be sent to them by the Committee proposed by the Federation. He did not know whether Mr. Perry suggested that the Association should take independant action on this matter, but it seemed to him that there should be a reasoned statement from industry as a whole, which was probably what was in Mr. Perry's mind, which could be presented to the country. He suggested that the Association should wait until the Special Committee, which had been appointed by the Federation had sent them a request for their views and that they should then get the information from their members. He believed that the intelligence and statistical work which the Association had done during the past two years would be of great assistance in the consideration of this important problem. He urged that there should be no hasty expression of opinion, but that the matter should be carefully investigated to its logical conclusion. This question was not going to be settled to-day, to-morrow, next month or in six months. The whole economic system of this country had existed merely because it had paid us. That system would cease to exist when it ceased to pay us, and this country would always be prepared to adopt whatever scheme appeared likely to pay us. He suggested that the matter should not be put at a higher level than that. Thus he urged that we should prepare our figures with the greatest care, so that we could present to the Federation of British Industries a reasoned case on behalf of chemical manufacturers.

After the Chairman had put the resolution to the meetng, and declared the Report and the Accounts unanimously adopted, the meeting expressed a wish that the Council of the Association should proceed to collect all the necessary details with a view to expressing an opinion on behalf of chemical industry on the two problems of extended safeguarding and Empire Free Trade.

ROSS INSTITUTE AND MALARIA.

Judged by the success attending the activities of the Ross Institute in fighting Malaria longvity will be extended in Africa in the future. A report says that Sir Malcolm Watson, head of the malaria prévention department of the Ross Institute, has just returned from a survey of the anti-malerial work which his department is doing amongst the new copper mines of Rhodesia. He said yesterday that next year the death rate from maleria there will be no higher than in England.

"Rhodesia is definitely a white man's country," he said. "A new belt of very rich copper ore is now being developed. Maleria is not very bad there, but for three months of the year it was suffieient at times to interfere seriously with the work, so it was decided to start preventive measures at once. Maleria is now under effective control."

In connection with a big colonisation scheme being considered by the Union Government, Sir Malcolm advised a thorough scientific survey of the various kinds of mosquitoes first, so that time and money need not be wasted in controlling harmless ones.

GENERAL NOTES

ENGLAND LEADS IN PLANS FOR SHARING PROFITS WITH EMPLOYEES.

Many business men have given much thought to the working out of a plan for sharing profits with employees which would stimulate their interest while being fair to the owners of the business and which would be financially sound. They have found the subject a difficult one and one concerning which is was not easy to discover how pioneering attempts along this line have turned out.

A very comprehensive study of this subject has now been made, covering Great Britain and the United States, and it is clear from it that this country has been definitely in the lead in working out satisfactory plans of this sort. Of the plans studied in the course of the survey were those of 12 well-known British firms—The Bradford Dyers' Association, Ltd., Bradford; Clarke, Nicholls & Coombs, Ltd., London; The Croydon Gas Company; William Gray & Co., Ltd., West Hartlepool; Lever Brothers, Ltd., Port Sunlight; R. S. Murray & Co., Ltd., London; Hans Renold, Ltd., Didsbury; South Metropolitan Gas Co., London; J. T. & J. Taylor, Ltd., Batley; Richard Thomas & Co., Ltd., London; Tootal Broadhurst Lee Co., Ltd., Manchester, and Edward Wood & Co., Ltd., Manchester.

The plan of the South Metropolitan Gas Company was started as long ago as 1889, with that of Messrs. Clarke, Nicholls & Coombs, Ltd., a year later and J. T. & J. Taylor in 1892. Among the British companies Lever Brothers have paid to their associated partner-workers nearly £2,000,000 in the 20 odd years the scheme has been in force.

The experience of American companies is no less interesting, and many unusual methods have been tried in seeking a means of uniting in one enterprise the best efforts of workers, managers, and owners. The survey describes the General Motors plan, known as the Managers' Securities Co., which is known to have made millionaires of a whole group of younger executives in that huge organisation.

The survey discusses such related topics as the amount, basis, time and form of distribution; provisions in case of death; sharing with employee shareholders; the [illegible] savings pool plan; other savings plans; definitions of the term "executive,"; and finally the results over a long term of years of various plans.

The survey has been made by the Metropolitan Life Insurance Company of New York, and we understand copies may be obtained on application to its British Isles Head Office, Bush House, Aldwych, W.C.2.

CADMIUM.

Cadmium, a by-product obtained in the production of zinc, was produced in Canada for the first time early in 1928 at Trail, British Columbia, by the Consolidated Mining and Smelting Company of Canada. The original recovery plant, with a capacity of about 1 ton of refined cadmium a day, treated the accumulated cadmium residues from the zinc plant. A new plant completed in the autumn of 1929 with a capacity of 1½ tons of refined cadmium a day, treats the regular output of the zinc plant, which is of lower grade than the old accumulated residues.

Production in 1929, as given by the Dominion Bureau of Statistics amounted to 773,976 pounds valued at $696,579, as against 491,894 pounds valued at $341,374 in 1928.

Exports of cadmium are mainly to England and France, and a small quantity also goes to the Orient. Cousiderable quantities of the metal are consumed in Canada, chiefly for plating purposes, and this use, because of its connection with the automobile and radio industries, has developed rapidly and has increased consumption beyond expectations.

The world's production of cadmium in 1928 amounted to 1,380 tons. Complete figures for 1929 have just been issued, the output reaching 2,000 tons. The chief producers, in order of their importance, are the Anaconda Smelting Company of Canada, the Electrolytic Zinc Company of Australia, and the American-Geischa A.G., in Upper Silesia.

The possibilities of increased production are great, but the market is rather restricted Also, as cadmium is obtained from the zinc smelters and electrolytic zinc plants, the potential supply is very much dependent on the world's output of zinc. Much of the new production is from electrolytic zinc plants where a high recovery of cadmium is obtainable, and this will offset the gradual exhaustion of old accumulated residues.

OUR DUSTLESS ROADS.

The Public and the Gas Industry.

Few of the hundreds of thousands of people who use the great arterial highways linking London with important provincial towns realise how much of the enormous progress in road-making in recent years is due to the early enterprise of the Gas Industry.

Motorists can hardly conceive what would have been the state of the roads of only 30 years ago if the present-day volume of traffic had been thrust upon them. Tar has been the great factor in achieving the modern dustless road. In the current issue of the *Co-partnership Journal* of the South Metropolitan Gas Company, it is pointed out that though tar macadam roads were laid in Nottingham as early as 1840, the demand for a really clean and even road surface was not met until the present century.

Gas engineers then discovered that the tar produced in the manufacture of gas could be so treated by distillation as to meet the demand of the growing number of motorists. It was found that the use of this tar rendered the roads more impervious to moisture and to the action of frost, and prevented the formation of mud and dust. It also acted as a most efficient binding agent and kept the roads free from loose stones.

Within a few years the advantages of tar spraying were generally recognised. In 1907, the Roads Improvement Association organised a competition to find out the best mechanical means for spraying tar on road surfaces in such a manner that it would bind the materials together and not merely form a coating. The competition was held near Ascot, and a distinguished company watched the effect of the treatment. In the competition for the best preparation, the judges found that the best submitted was a sample of distilled tar supplied by the South Metropolitan Gas Company.

Even though tar spraying is such a boon, the tar sprayers are still looked upon with some disfavour. Yet all who enjoy the advantages of dustless roads, who throw open their windows with impunity, and who wander through the country without being covered with dust, reap the benefits of the enterprise of the gas industry.

TWO LARGE NITRATE PLANTS FOR CHILE.

As soon as the new Chilean nitrate combined, Cosana (Compania Salitrera Nacional), is legally constituted, the company will construct two great nitrate plants, each with annual capacity of 700,000 tons, says a Santiago cable to the "Wall Street Journal." These plants will replace those compelled to work under difficult economic conditions. To finance the construction of these factories, Congress has authorized loan of 1,000,000,000 pesos, most of which it is hoped wilf be floated in New York.

It is understood that the nitrate company will at first concentrate on the best plants in Chile, following the old process of elaboration until plants on a larger scale can be installed to operate on the Guggenheim process.

Chilean and Spanish nitrate leaders have drafted a plan to regulate the sale of Chilean nitrate in Spain, involving the formation of a company with capital of 1,000,000,000 pesetas, to be subscribed equally by Chilean producers and the Foreign Bank of Spain (*Banco Exterior de Espana*). The company will be known as Sociedad Espanola de Nitratos de Chile.

Similar organization is under consideration for establishment in France, and negotiations are said to be proceeding satisfactorily. It is understood that Jacques Guggenheim will head the French Company Chemicals.

BRITISH INDUSTRIES FAIR.

Record Bookings in London an Birmingham.

Four-fifths of the space in the British Industries Fair to be held at Olympia, London, and Castle Bromwich, Birmingham, from February 16 to 27 next year has already been let, the total area booked in the two sections up to August 1st. amounting to more than 400,000 (four hundred thousand) square feet.

In the London Section, where the area avaiable is 300,000 (three hundred thousand square feet, bookings up to August 4th amounted to 236,000 (two hundred and thirty six thousand) square feet which is more than the amount booked at this time of year for any previous fair.

"Taking into account the general trade depression and the holidays, the eagerness of manufacturers to exhibit is regarded as very satisfactory," an official said.

Proceedings & Noticies of Societies.

ROYAL SOCIETY OF ARTS SEVENTH ANNUAL OPEN COMPETITION OF INDUSTRIAL DESIGNS, 1930.

The Exhibition of works submitted for this year's Royal Society of Arts Competition of Industrial Designs will remain opened to the public from August 2nd to August 31st at the *Imperial Institute*, South Kensington. The most successful competitor is Miss Mary Kirby of Middlesbrough, a student of the Slade School of Art (University of London). The Judges in the Textile Section "unanimously and unhesitatingly" awarded Miss Kirby the Tootal Broadhurst Lee Travelling Studentship of £75 for her designs for Dress or Furnishing Materials; she has also won the James H. Hyde Travelling Scholarship of £100 and Messrs. *Simpson & Godlee's first prize of 25 guineas for* designs for printed Cotton Dress Cloths. This is the third time that the Tootal Broadhurst Lee Studentship has been gained by a student of the Slade Scrool of Art, the prizewinners of 1927 and 1928 having come from the same school. Another prizewinner is Harold Hemingway, a student of the Rochdale School of Art, who has been awarded the Art Congress Studentship of £50, in addition to the first prize of £15 and *the third prize of £5 offered by British* Celanese Ltd., *for designs for printed* Silk Fabrics for Dress Wear. Leeds College of Art ranks first amongst the other Institu-
..ns in the list of awards, the undermen-
Compat.students from the College having
with that following prizes :—Clarence Scott
Coombs, Ltd., £30 offered by the Orient Line
Taylor in 1892. Francis F. Johnson—first
panies Lever Broi offered by Messrs. Bratt
associated partner-ve Heaped Fire Company
000 in the 20 odd yearlace; Ronald Addis—
in force. ..y the Cunard Steam
The experience of AmPoster; Edwin J.
no less interesting, and ma.f £15 offered by
ods have been tried in seek Ltd. for a de-
uniting in one enterprise the dney Harry—
workers, managers, and ownMessrs. Turn-
vey describes the General for Printed
known as the Managers' Scollege of Art
which is known to have madring achieved
of a whole group of younger Jean Cowan
that huge organisation. first prize of
The survey discusses such re Medal, for
as the amount, basis, time and prize of
distribution; provisions in case mpson &
sharing with employee shareholdM. B.
Paisley—a prize of £12 10s. 0d. offered by Morton Sundour Fabrics Ltd., for Cretonne; Miss Margaret Leeds—the third prize of 10 *guineas offered by Messrs. Simpson & Godlee* for Cretonnes; Miss Wilfred I. Thorburn—the second prize or 10 guineas offered by Messrs. Story & Co., Ltd., for Cretonnes.

The prize offered by the Peninsular & Oriental Steam Navigation Company for the best design for the furniture of a single berth cabin has been won by Frank W. McCall of Edinburgh. This prize consits of 2 tickets of the value of 20 guineas each on any P. & O. *Fortnight's summer cruise* together with 10 guineas in cash for expenses.

The prize of £50 offered by the British Poster Advertising Association for a Poster to advertise the advantages of poster publicity was divided between William Hobson of Leeds and Alfred J. Wray. a student of the Hackney Technical Institute School of Art, the former receiving a prize of £30 and the latter a prize of £20.

The prize of £25 offered by the British Electrical Development Association for a Poster advertising the uses of Electricity in Rural Districts was divided between Charles D. Morgan, a student of Liverpool City School of Art, who receives £15, and John F. Lawrie *a student of Bournmouth School* of Art, who was awarded a prize of £10.

Frederick B. Hayes, a student of the Bath School of Art, was awarded the prize of £25 offered by the Blackpool Corporation for a design depicting that town's Illuminations.

Charles E. Phillips of Vancouver, British Columbia, has taken the first prize for typography in the Book Production Section; and *other awards in the Competition have been* gained by British competitors from Cornwall, Magog and Vancouver, in Canada; Melbourne, Australia; Cape Town, South Africa; Surat, India; and from Paris and Munich.

Students from the following Schools of Art have also gained prizes in this year's camPetition :—Battersea, Burslem, Camberwell, L.C.C. Central School, Glasgow, Glossop, *Halifax, Hammersmith, Hornsey, Hyde*, Kidderminster, Macclesfield, Nottingham, Putney, Royal College of Art, Salford, Sheffield, Stoke-on-Trent, Sunderland and Watford,

NOTICES OF BOOKS.

Up to-Date Farming with Cyanamide. European Cyanamide Export Company Ltd., Agricultural Dept., Adelaide House, London, E.C.4.

Cyanamide, the cheapest nitrogenous fertiliser in the market, contains 20.6 per cent. nitrogen and about 60 per cent. lime. In view of the marked increase of its use in recent years, it is felt that farmers and others will welcome accurate and up-to-date information concerning its special properties.

It is less liable to leaching than most other inorganic forms of nitrogen, yet its action is intermediate between the quick-acting nitrates, and organic fertilisers such as dried blood. Owing to the chemical reaction which takes place between cvanamide and the moisture of the soil a sufficient interval must be allowed between its application and the sowing of the crop, to avoid all possibilit- of influencing germination adversely.

In addition to its uses as a fertiliser, it is perhaps the most effective chemical agent for the destruction of weeds, and for checking the growth of weed seeds in soil. By applying cyanamide as a top dressing to corn under favourable conditions, charlock can be destroyed, and, moreover, the soil receives at the same time a valuable dressing of nitrogen and lime.

This valuable fertiliser enables the farmer to obtain increased yields of better quality, and at the same time lowers the cost of production on the farm.

NEW PUBLICATIONS.

From the High Commissioner for Canada (London).

I. General Review of investigations : by W. B. Timm.

II. Reports of investigations—Ore Dressing and Metallurgical Laboratories : by C. S. Parsons, A. K. Anderson, and J. S. Godard.

III. Reports of investigations—Non-Metallics Laboratory : by R. K. Carnochan, C. S. Parsons, and R. A. Rogers.

IV. Reports of investigations—Hydrometallurgical Laboratory : by R. J. Traill, W. R. McClelland, and J. D. Johnston.

V. Report on the work and investigations of the Chemical Laboratories : by H. C. Mabee.

VI. The new Pyrometallurgical Laboratory of the Department of Mines : bv W. B. Timm and T. W. Hardy.

Forthcoming Events.

THE INSTITUTE OF METALS.

AUTUMN MEETING, SOUTHAMPTON.

Programme :

Tuesday, September 9, at 8 p.m.—Ninth Autumn Lecture, by Professor D. Hanson, D.Sc. (Vice-President), on : "The Use of Non-Ferrous Metals in the Aeronautical Industry."

Wednesday, September 10, at 9.30 a.m.—General Meeting. Papers will be presented and discussed.

Papers :

The following papers are expected to be submitted :—

"Pendulum Hardness Tests of Commercially Pure Metals." By D. A. N. Sandifer, M.Sc.

"Pressure Die-Cast Aluminum Alloy Test-Pieces." By J. D. Grogan, B.A.

"Gas Removal and Grain Refinement of Aluminium Alloys." By W. Rosenhain, D.Sc., F.Inst.Met., F.R.S., J. D. Grogan, B.A., and T. H. Schofield, M.Sc.

"The Effects of Phosphorus on the Strength of Admiralty Gun-Metal." By H. C. Dews.

"The Artificial Ageing of Duralumin and Super-Duralumin." By K. L. Meissner, Dr.-Ing.

"Lattice Distortion as a Factor in the Hardening of Metals." By W. L. Fink, M.S., Ph.D., and K. R. Von Horn, M.S., Ph.D.

"A Study of the Relation between Macro- and Microstructure in Some Non-Ferrous Alloys." By Marie L. V. Gayler, D.Sc.

"The Diffusion of Aluminium into Iron." By N. W. Ageew, Met.Eng., and Olga I. Vher, Min.Eng.

"A Note on the Constitution of the Cadmium-Zinc Alloys." By D. Stockdale, M.A., Ph.D.

"On the Determination of Crystallite Orientation." By Prof. Dr. G. Tammann, Geh. Reg.Rat.

"Rolled Gold : Its Origin and Development." By Ernest A. Smith, A.R.S.M.

"Heat-Treatment, Ball-Hardness, and Allotropy of Lead." By F. Hargreaves, A.R.S.M., D.I.C.

"The Effect of Two Years' Atmospheric Exposure on the Breaking Load of Hard-Drawn Non-Ferrous Wires." By J. C. Hudson, D.Sc., D.I.C., A.R.C.S.

"The Open-Air Corrosion of Copper. Part II.—The Mineralogical Relationships of Corrosion Products." By W. H. J. Vernon, D.Sc., Ph.D., and L. Whitby, M.Sc.

"Silicon-Copper Alloys and Silicon-Manganese-Copper Alloys." By E. Voce, M.Sc., Ph.D.

"A New Silicon-Zinc-Copper Alloy." By E. Vaders.

SMOKE ABATEMENT CONFERENCE.

The Annual Conference of the National Smoke Abatement Society will be held at Leicester on September 26, 27, and 28. A programme of exceptional interest is expected to ensure the presence of many members and municipal delegates.

Fuel Research and Smoke Abatement.—Dr. Margaret Fishenden, the expert on smokeless fuels and methods of heating, will give a paper on this subject.

Smoke and Weather.—A meteorological expert will discuss in what ways the smoke-laden atmosphere affects the weather, and how the two subjects are related.

The Smoke Nuisance as the Airmen Sees It.—The important question of visibility is always a problem for the airman, but the smoke pall over the cities and towns very greatly increases his difficulties. This is the first time that this new and pressing indictment against coal smoke has been dealt with at a conference of this nature.

The Problem in Sheffield.—The special and difficult questions arising from smoke in the iron and steel industries has recently been examined by the Sheffield Manufacturers' Smoke Abatement Research Committee, and the report, by F. J. Bailey and E. C. Evans, will be very fully discussed.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

22,138.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of derivatives of 3-nitro-4-hydroxy-benzamide. July 22nd.

22,258.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of halogen anthraquinone - β_a - (N) - benzacridones. July 23.

22,259.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of halogen derivatives of anthraquinonebenzacridone series. July 23.

Specifications Published.

303,900.—Polanyi, Dr. M., and Bogdandy, Dr. S. Von.—Apparatus for the production of chemical compounds.

332,250.—Winter, R. M., and Imperial Chemical Industries, Ltd.—Method of concentrating caustic alkalis.

332,203.—I. G. Farbenindustrie Akt.-Ges. Process for the manufacture of dyestuffs of the anthraquinone series.

Printed copies of the full published specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2., at the uniform price of 1/- each.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

DUROSALT.

513,821.—All goods in Class 1 which include acids, potash, salts and other chemical substances used in manufactures. —British Dyestuffs Corporation, Limited, Hexagon House, Blackley, Manchester. July 23. (Associated).

PROMEUM.

513,940.—All goods in Class 1 which includes acids, potash, salts and other chemical substances used in manufactures. —Lewis Berger & Sons, Ltd. 201, Morning Lane, Homerton, London, E.9. July 23.

IONLITE.

513,244.—Chemical substances used in manufactures, photography, or philosophical research, and anticorrosives, but not including paints and enamels (being in the nature of paints), and not including any goods of a like kind to these excluded goods.—Ionlite, Ltd., 64, Newman Street, London, W.1. July 30th.

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NOTICE TO AUTHORS & CORRESPONDENTS

Contributions for publication either as original articles or in the correspondence columns are welcomed by the Editor of *The Chemical News.*

They must be accompanied by the contributors' full names and addresses, not necessarily for publication, but as an indication of good faith. If a reply is needed or if it is desired that a manuscript which is not accepted for publication be return... velope shoul...

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No ... ymous letters

THE METAL CRYSTAL.

By SIR HAROLD CARPENTER, M.A., Ph.D. F.R.S.

(*Royal Institution of Great Britain, Friday, May 20, Sir Robert Robertson, K.B.E., D.Sc., LL.D., F.R.S., Treasurer and Vice-President, in the Chair.*)

THE PROPERTIES OF SINGLE CRYSTALS. MECHANICAL PROPERTIES.

Concluded from page 180.

I have already had occasion to comment on the remarkable softness of single-crystal bars, which necessitates great care in their handling and machining, and differentiates them from the same metals in the poly-crystalline form. This is precisely what we should expect from a metal possessing the uniform orientation of a single crystal, and constitutes strong evidence that the bars really are single crystals. It has been known since the work of Ewing and Rosenhain at the end of last century, that the plastic yielding of a metal is due to slip along certain planes along which it yields more easily than in other directions. Even so, the ease with which single-crystal bars of aluminium, copper, silver, and gold, and even iron, can be deformed is astonishing. Each of these metals can be bent very readily, but once it has been bent to any marked extent, a higher stress is required to make it revert to its original shape. This simply means that it has been hardened under distortion and the uniform crystal pattern of the atoms altered. Whether this is due, as Miss Elam and I have suggested, to the uniform bending of the crystal planes, or whether, as Gough, Hansen, and Wright have suggested, the distortion of the crystal plane is such that the average curvature is small and of the nature of "rumpling," cannot as yet be decided.

The softness of single-crystal bars indicates that they can only possess a very low limit of proportionality under stress, and indeed raises a doubt whether they can properly be described as possessing any limit of proportionality at all. This point has been carefully tested by Gough, Hanson and Wright[21] in the case of the metal aluminium. The limit of proportionality in tension of a polycrystalline bar is just about one ton per square inch. These investigators found that the single-crystal bars possess no primitive limit of elasticity, but plastic straining occurred under the least stress applied. Furthermore, they conclude from the slope of the stress strain diagram, even at the 10-40 lbs. range of load, that no primitive state

of elasticity existed. It is clear, therefore, that the well-defined elastic limit found in the polycrystalline bar is not a property of the metal crystal but of the crystal aggregate in the case of aluminium.

The common and useful metals belong to one of three types of crystal structure—the face-centred cubic, the body-centred cubic, and the close-packed hexagonal lattice, and it is significant that each of these represents a very high degree of crystal symmetry. These have certain structural features in common. Planes of atoms exist in which the units are closer together than they are to their neighbour in the next plane. Even in the same plane, however, there are certain lines in which the atoms lie closer together than they do in other directions. When a crystal is stretched or compressed it tends to yield on certain planes and along certain directions in which the forces binding the crystal together are the weakest.

The deformation and ultimate fracture of a single-crystal test-piece was first carried out in the case of the metal aluminium. The first experiments were qualitative and showed at once that the tensile properties of this metal are directional. On the one hand, a round polycrystalline bar pulls out like an isotropic material. It undergoes general extention, and finally breaks with considerable reduction of area and yields a cup and cone fracture. This is the result of bent slipping. *The cross section of the test-piece is round* at any point although the surface is roughened, due to the unequal distortion of the minute differently oriented crystals. On the other hand, when a round single-crystal bar is distorted under tensile stress it becomes an ellipse. As distortion proceeds the ellipse becomes sharper and sharper. A point *is reached when a curious and characteristic* lens-shaped figure, inclined at an angle to the long axis of the test-piece, makes its appearance. Finally the bar breaks at this point with a characteristic " wedge " fracture. In this test the surface of the test-piece is not roughened, but is mechanically etched with numerous slip lines which are known as " glide ellipses." Considerable variations in the ductility and ultimate stress of different test-pieces are found due 2. differences in the orientation of the single stal, relative to the axis of the test-e. The ductility is in some cases nearly 22,25 times as great as in the polycrystalline vhereas the ultimate stress is considerss. and in no case exceeds 80 per cent. of the polycrystalline metal.

The first complete mathematical and quantitative analysis of the distortion of a single metal crystal was also carried out on aluminium, and forms the subject of the Bakerian Lecture by Taylor and Elam in 1923.[22] The analysis was carried out on a square bar machined from a round bar, and involved the marking of each face with a *scratch parallel to the length of the axis of* the specimen and by cross scratches at 0.5 inch intervals. The dimensions of the test-piece were $1.0 \times 1.0 \times 20.0$cm. The faces were numbered 1, 2, 3, 4, so that when the specimen was placed upright in the testing machine the faces appeared in this order when the observer in the testing machine the faces appeared in this order when the observer moved round the machine in an anti-clockwise direction. At each successive stage of the test the extension between each pair of cross marks was measured on each face. The angles between cross scratches and longitudinal scratches were also measured. In addition the thickness of the specimen between the pairs of opposite faces *and the angle between neighbouring faces* were also measured. These sufficed to determine the nature of the distortion.

These investigators found that up to an extension of 40 per cent. elongation the crystal distorted by slipping or shear on one plane. This plane was found by X-ray measurements to be an octahedral plane (111) of the crystal. The direction of shear *was also determined and found to be along* one of the three principal lines of atoms in the octahedral plane. When the specimen was extended beyond 40 per cent. elongation it was found that the distortion was no longer due to slipping on one plane. This was explained by the authors, who showed that the effect of the shear was to rotate the *axis of the specimen relative to the crystal* axes in such a way that another octahedral plane came into a position where its inclination to the axis was the same as that of the slip plane. Under these circumstances it was clear that slipping might occur on both planes simultaneously, and it was verified that this was the case.

This investigation furnishes the explanation of the drawing down of round single-crystal test-pieces of aluminium in the tensile test into very acute ellipses. It is due, *viz.*, to the slipping of the crystal on two conjugate planes. It established a further important point. Hitherto, the evidence with regard to the yielding of a metal by slip had been purely qualitative. It had not been shown that the deformation when a

metal crystal is strained is such as could be produced by slip. The quantitative measurements in this paper showed for the first time that this is the case, and it has been left to Taylor and Elam to complete in this way the original discovery of Ewing and Rosenhain.

Their second paper[23] on the plastic extension and fracture of aluminium crystals contains a most interesting test. Previously they had analysed in a similar way the distortion of other single-crystal bars in which slipping begins on one plane and afterwards continues on two, when the bar has moved into the position of conjugate slipping. They predicted that if the crystal axis of the unstrained crystal were originally in the position where double slipping could occur, it should begin at once. Among the large number of crystals grown by Miss Elam and myself one was found, the axis of which corresponded very closely to this position. On distorting this in tension it was found that double slipping began almost at once, and continued throughout the whole of the remainder of the extension. Not only this, but the amount of slipping which occurred on the two planes was practically equal, and the axis of the specimen hardly changed during the whole of the test. One other conclusion also follows from these tests, *viz.*, that whatever the original orientation of the crystal in the test-piece, it always breaks in the same position.

The question then arises, does the single crystal remain a single crystal throughout the extension up to fracture, or does it break up? Evidence on this point is contained in Müllers paper (*loc. cit.*) in the character of the spots reflected by X-rays. In the unstrained specimen the reflected spots are very small and only obtained within a small setting angle. When extension began the range of reflection frequently increased, and the size of the reflected spots became larger. Assuming that the material does break up into small crystals, it is possible from the dimensions of the reflected spots to make a rough estimate of the maximum angle between the surfaces of a pair of these small crystals. It was found that this angle amounted sometimes to several degrees. Müller infers that this result shows the actual breaking up of the test-piece into smaller crystal aggregates. As, however, these remain even after a considerable extension of the test-piece very nearly in the same position, the test-piece can still be microscopically considered as being a single crystal. A Laue photograph was taken of a test-piece at the very edge where the specimen was broken. The pattern which resulted showed the existence of relatively large crystals near the edge. It is clear from this that the metal crystal exhibits great resistance to destruction by mechanical stress.

It is well known that when a metal is distorted in tension it breaks by sheer stress, and that this is at a maximum at 45° to the long axis of the test-piece. Supposing that aluminium were a stronger metal, and that it were possible to break it by sheer stress on one plane, and supposing that we could find a single-crystal test-piece whose plane of slip was oriented at 45° to the longer axis, we should expect the fractured surface to be not a wedge but a plane surface inclined at 45° to the test-piece. Since we cannot do this with aluminium, owing to its weakness, it seemed interesting to discover whether it could not be hardened by the addition of an alloying element which does not destroy its crystal symmetry, and that it might thus be made to have the property of slipping only on one plane before it fractured. Miss Elam succeeded in doing this by dissolving 18.6 per cent. of zinc in aluminium, and this in spite of the fact that the lattice of zinc is not face-centred cubic but close-packed hexagonal. This is a one-phase alloy. It was converted into a single-crystal test-piece by the method of critical straining and heat-treatment, and was then tested in tension. It pulled out almost entirely on one principal cleavage plane, although there were signs of a second plane on which slipping had occurred at approximately 90° to it. Both planes made angles of approximately 45° with the axis of the test-piece. It is clear, therefore, that fracture did occur on the plane of maximum sheet, which is in strict accordance with theory. So far as I am aware, this is the first time that it has been possible to test this.

Taylor and Farren, in a paper on the distortion of aluminium crystals under compression[24], have found that this is of the same nature as that which occurs in tension. It is due to slip parallel to a certain crystal plane and in a certain crystallographic direction, and the choice of which of twelve possible crystallographically similar types of slipping actually occurs, depends only on the components of sheer stress in the material, and not at all on whether the stress normal to the slipping planes is a pressure or a tension.

The study of the distortion of single crystals of iron has yielded results of quite remarkable interest. The lattice structure of

this metal is different from that of aluminium. It is body-centred cubic, *i.e.*, there is an atom at each corner of the cube and one in the centre. The planes having the largest number of atoms and the largest distance between neighbouring planes are not the same type as in the body-centred cubic lattice. For this reason alone, therefore, it was important to study the distortion of the single iron crystal. But there was a further reason. The slip bands of the majority of metals formed in plastic deformation are straight, whereas those of iron are nearly always curved. Nearly all previous workers in this subject have assumed that the iron crystal has a plane of slipping which is a crystal plane, and they have attempted to correlate the slip lines with the traces of crystal planes. These attempts have not met with success, but the work of Osmond and Cartaud[25] constitutes a notable exception. They pointed out that the slip lines which occur when an iron crystal is strained are curved, and they could find no relationship between these either as a whole or in their detail and the crystallographic planes.

Taylor and Elam studied the distortion in tension of single iron crystals prepared by Edwards and Pfeil[26]. They concluded that when an iron crystal is distorted in tension it does not slip along a crystallographic plane, but that the particles of metals "stick together along a certain crystallographic direction, and the resulting distortion may be likened to that of a large bundle of rods which slide on one another. The rods stick together in groups or smaller bundles of irregular cross sections, and the slip lines which appear upon the polished surface are the traces of these bundles on that surface." This conclusion has been tested by Gough, who subjected a single crystal of iron to alternating torsional stresses. The specimen was ultimately fractured by fatigue, precautions being taken to prevent the development of fatigue cracks to any great extent. Careful microscopical examination showed that the slip bands differed entirely in appearance at different portions of the specimen, but all bands could be described as belonging to one of the following types :—(1) One set of straight parallel bands, (2) two sets of bands of differing slopes, those of each set appearing to be straight or nearly so, and (3) distinctly "wavy" slip bands having a well-defined average slope and limits of slope but impossible to resolve into combinations of straight slip bands. Gough's analysis led him to the conclusion that alpha iron does slip on crystal planes, but that instead of it always taking place along planes of one type, it may take place on any of the (112), (110) or (123) planes. It is only under very special conditions that any one of the planes will coincide with the plane on which the value of the sheer stress resolved in the octahedral direction is the maximum. In general, therefore, slip will occur on two sets of planes simultaneously. It is this which gives rise to the generally curved nature of the slip bands and the very complicated arrangement of which the duplex and "wavy" bands are types. This is the view of the distortion of the single iron crystal which is now generally accepted. The character of the slip accounts for a property of iron of the highest importance, *viz.*, its tendency to break with a fibrous fracture.

Physical Properties.

Plasticity is only one of the properties of metals. It is one of the greatest importance to engineers and metallurgists, but from the general standpoint of physics all properties are important. Physicists have recognised in single crystals a new approach to many of their problems, and each year this form of metal is being used to an increasing extent as a means of obtaining data on some of the fundamental phenomena of matter. Magnetic, electrical, thermal and optical properties have been measured for crystals of many metals and of different orientations, and it is only possible to mention a small proportion of this work.

Magnetic Characteristics.

Investigations of the magnetic properties of single crystals of iron have been carried out by Honda, Kaya, and Mashiyama.[27] They prepared single crystals of iron wire $68.1 \times 2.4 \times 1.81$ mms. by the method of critical straining and heating. They found that the hysteresis loss of a single crystal of iron is only one tenth of that of ordinary transformer iron, and that it increases rapidly with increase in the number of crystals in unit volume. The initial and maximum permeabilities of iron were found to decrease with the number of crystals in unit volume.

A set of five crystal rods, of which three had their axes approximately lying in the (100) plane, and two in the (110) plane, was prepared. The magnetic expansion of these rods was measured, and the following observations were made :—

(1) The magnetic expansion of single crystals of iron is generally very large as compared with that of ordinary iron. (2) The magnetic expansion in the direction of the tetragonal axis is always positive, whereas in that of the trigonal axis it is

always negative. (3) The magnetic expansion curves for crystals of intermediate orientations are determined by the resultant of the above expansion and contraction. (4) The magnetic expansion in ordinary poly-crystalline iron is a differential effect of the expansions and contractions of the numerous crystals of random orientations. The work of these Japanese investigators has therefore demonstrated that hysteresis loss and permeability are functions of the number of crystals in unit volume, and that magnetic expansion is a directional property of the crystals.

A similar research was carried out by Gerlach[28]. The results obtained were in substantial agreement with those of Honda and his co-workers, and the magnetic properties of single crystals were shown to be definitely directional. It was found that the initial permeability is greater in the titragond than in the digonal direction, and that saturation in the tetragonal direction occurs at a lower magnetic force than in the digonal direction. This investigator found that slight deformation produces considerable changes in magnetic properties, and attributed the small discrepancies between his results and Honda's to the existence in the latter of slight mechanical disturbances. The effect of these was most marked in the curves connecting field intensity and intensity of magnetisation.

The longitudinal magneto-resistance effect in single crystals of iron has been measured by Webster.[29] He measured the change of resistance in a longitudinal magnectic field for three different orientations of iron crystals. He found that for the tetragonal direction there is no change in resistance in a longitudinal magnetic field, whereas in the trigonal and digonal directions the electrical resistance begins to alter when a magnetic intensity of about 800 c.g.s. units is attained.

Various magnetic properties of nickel crystals have also been determined, principally by Kaya. This investigator found that up to an intensity of magnetisation of 205 c.g.s. units nickel crystals are isotropic, but that above this intensity the magnetisation varied for different directions of the applied field. Trigonal, digonal, and tetragonal axes are in decreasing order of magnetisability, which is the reverse of the order found for iron. The same investigator measured the change in electrical resistance of single nickel srystals in longitudinal and transverse magnetic field. In a longitudinal magnetic field every direction of the amount of increase being in the decreasing order [111] [110] and [100]. These results differ from those obtained by Webster, who found no increase in resistance for the [100] direction in iron crystals.

The magnetic expansion of single crystals of nickel has been measured by Mashiyama. He found that in a longitudinal field the magnetic expansion is always negative for all fields and in all directions, and that the absolute amount of contraction decreases in the order of direction of [100] [110] [111]. The transverse effect was found to be the opposite of the longitudinal.

ELECTRICAL CONDUCTIVITY.

A considerable amount of work has been done on the electrical conductivity of single crystals, and in general it has been found that for those belonging to the cubic system the resistivity is the same in all directions, while for those in other systems the greatest resistivity is found to be in the direction of the planes on which slip most easily occurs.

In comparing the difference between single crystal and poly-crystalline bars of zinc with respect to thermal and electrical conductivity over the range −250°C. to +100°C., Lewis and Bidwell found that: (1) The thermal conductivity decreases smoothly but not linearly with rise in temperature. (2) Single crystals of zinc, measured in the direction of the basal plane, have 11-18 per cent. better thermal conductivity at 0°C. than polycrystalline bars. (3) Single crystals of zinc, have 20-30 per cent. less electrical conductivity at 0°C. than polycrystalline bars.

Bridgman has conducted numerous investigations on the conductivity and thermal E.M.F. of crystals of low symmetry. In 1926 he published a paper on the Thermal Conductivity and Thermal E.M.F.[30] of Single Crystals of Zinc, Bismuth, Cadmium, and Tin. Both properties were shown to vary with the orientation of the crystals, and this variation was particularly marked in the case of the thermal E.M.F. Using improved methods of casting single crystals which permitted the production of a wide range of orientations and a more accurate means of measuring the thermal E.M.F. and resistance, he was able in 1928[31] to demonstrate more clearly the relation between these properties and the orientations of the crystals. He found that the thermal E.M.F. was a linear function of $\cos^2\theta$, where θ is the angle between the axis of the crystal and the length of the rod. This verifies the relation of Kelvin and Voigt, about which Bridgman on the basis of his

Density.

It has been found that the density of iron single crystals is 0.037 per cent. greater than that of the polycrystalline material, and that the density of aluminium single crystals is 0.034 per cent. greater than that of the polycrystalline materials.[32]

Electromotive Characteristics.

Measurements of the electrode potential of single crystals of zinc have been carried out at Yenching University, Peking, by Paul A. Anderson.[33] The results indicated that the primary cleavage plane of zinc—the basal pinacoid—yields constant and reproducible values of the electrode potential, and that this value is the same as that obtained from electrolytically deposited crystal conglomerates. This result seems to indicate that in the electrolytically deposited conglomerate the crystals have a random orientation, and that the basal pinacoid plane has the maximum electrode potential of all planes. Attempts to prepare zinc crystals with naturally developed secondary faces proved unsuccessful, and measurements of electrode potential were made on artificially prepared surfaces. The results obtained in this way indicated a qualitatively regular decrease of potential with increase in the angle between the plane under consideration and the primary cleavage plane.

An investigation of the relation between electrode potential and the density of the atom on different planes of zinc crystals has also been carried out in the University of Latvia.[34] The results obtained in this investigation did not agree with those already mentioned, and no difference could be found in the potentials of different, artificially prepared planes.

It is very probable that the electromotive characteristics of a metal vary with the orientation of the surface on which they are measured, but the variation in these characteristics is difficult to measure on artificially prepared surfaces. The Latvian investigators attributed the negative results obtained to this fact. They pointed out that polishing, filing, or rubbing with emery disintegrates the crystallographic planes, and the resulting structure is indefinite and shows no differences of potential, whereas etching with dilute acids attacks the surface very unevenly and no definite plane results. It is probable that the results obtained by Anderson were qualitatively correct, but definite confirmation of these results must await measurements of the electrode poten-

others which it has not been possible to include in this lecture, that both the mechanical and physical properties of the single metal crystals are, in the majority of cases, directional. This fact is more strikingly illustrated in the mechanical tests because the single crystal test-pieces undergo distortion and assume new and striking forms. In both categories, however, the properties of the single crystal differ from those of the crystal aggregate depending upon its particular orientation. Single crystal alloys have been investigated to a less extent, but, in so far as evidence is available, it indicates that the same holds for them. The scientific investigation of metals in the future will have to take into account both the monocrystalline and the polycrystalline states, and the variations in any particular property which may be secured by varying the orientation of the crystal. This will involve the controlled production of single crystals in particular orientations, a field of investigation which is only just being opened up.

Knowledge of the mechanics and physics of the metal crystal is only in its infancy. From the standpoint of pure science, it is the single metal crystal which will have to be investigated in the first instance. That of the crystal aggregate of any particular average size should follow at a later stage. Such knowledge will form the basis of the scientific manufacture of metals and alloys possessing properties which can be specified with accuracy and certainty.

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THE USE OF POTASSIUM TITANIUM OXALATE FOR THE PREPARATION OF A STANDARD TITANIUM SOLUTION IN COLORIMETRY.

By WILLIAM M. THORNTON, JR., AND REUBEN ROSEMAN.

(*Contribution from the Chemical Laboratory of the Johns Hopkins University.*)

The colorimetric estimation of titanium is based upon the fact that, when an acid solution of titanium is treated with hydrogen peroxide, a yellow or orange colour develops, the intensity of which increases with the amount of titanium present.[1] By comparing the colour of a peroxidised titanium solution of unknown strength with that of a standard solution similarly treated, one may arrive at a reasonably accurate estimation of the titanium in the former solution.

The standard solution is most frequently prepared by starting with recrystallised potassium fluotitanate ($K_2TiF_6.H_2O$). According to Washington,[2] this substance (1.61 grams) is evaporated four or five times with 5-gram portions of sulphuric acid (1 : 1)—not quite to dryness—in a platinum dish. This serves to remove the hydrofluoric acid which is known to exert a bleaching action on peroxidised titanium solutions.[3] The residue is treated with 5cm^3 of sulphuric acid (1 : 1), cold water is added, an additional 50 cm^3 of sulphuric acid (1 : 1) is introduced, and the volume made up with water to exactly 500 cm^3. In a measured portion of this solution (50 cm^3) the titanium is determined gravimetrically, and an accurate value for the standard is thus obtained.

At the suggestion of Dr. Henry S. Washington, of the Geophysical Laboratory, we have tried using another salt of titanium as the starting material for a standard solution of titanic sulphate; namely, potassium oxalate [$K_2TiO(C_2O_4)_2.2H_2O$]. Baker's C. P. salt was recrystallised once from water, and the crystals were dried at room temperature for several days. Enough of this material (about 4.5 grams) to contain 1 gram of titanium dioxide was mixed with 8 grams of ammonium sulphate, and this mixture placed in a 500-cm^3 Kjeldahl flask. One hundred cm^3 of concentrated sulphuric acid (sp. gr., 1.84) was added and heat applied gradually. At the beginning there was a slight foaming; but the liquid soon became calm. At length the solution was heated to boiling and maintained at that point for several minutes. The whole heating operation can be completed in 20 minutes, the solution being thereby freed from oxalic acid which, if present, might later bleach the peroxidised standard.[4] The resulting solution was diluted with water to 800 cm^3, cooled, poured into a 1-litre volumetric flask, and diluted to the mark; whereupon it was filtered and stored in a glass-stoppered bottle. One may test for the complete destruction of oxalate by adding a drop of potassium permanganate to a portion of the filtered solution. There should be no decolorisation of the permanganate.

By following the directions outlined above, two solutions were prepared: Solution 1, made in accordance with the proposed technique, and Solution 2, made as directed by Washington.[5] Both of these contained the same concentration of sulphuric acid; that is, 10 per cent. sulphuric acid by volume. The exact titanium content of these solutions was determined (in 50-cm^3 portions) by the "cupferron" method.[6]

Ten cm^3 of each of these solutions was pipetted into 100-cm^3 volumetric flasks, 5 cm^3 of hydrogen peroxide (Baker's 3 per cent. solution) added to each, and both made up exactly to volume with sulphuric acid (1 : 19). These solutions were compared in a Duboscq colorimeter (Bausch and Lomb model) and the results so obtained are shown in Table I.

TABLE I.

Experiment No.	Grm. TiO_2 per cm^3 of Solution 1, considering Solution 2 as standard
1	0.001013
2	0.000988
3	0.000993
4	0.000972
5	0.001011
6	0.000980
Average ...	0.000993
Found gravimetrically...	0.000992

[1] Schönn, Z. *anal. Chem.*, 1870, IX, 41, 330, first observed the yellow colour, developed when hydrogen peroxide is added to a solution of a titanium salt, although Weller, *Ber*, 1882, XV, 2592, is credited with having utilised this reaction as the basis of a quantitative process.

[2] Washington, "Manual of the Chemical Analysis of Rocks," p. 55, 1919. John Wiley and Sons, Inc.

[3] Hillebrand, *J. Am. Chem. Soc.*, 1895, XVII, 718.

[4] *Cf.* Hall, *J. Am. Soc.*, 1904, XXVI, 1241.

[5] *Loc. cit.*

[6] Thornton, "Titanium" (Amer. Chem. Soc. Monograph Series), p. 90, 1927. The Chemical Catalog Company, Inc.

Each experimental result represents the average of fifteen readings, five for each of three different settings of the plunger. Moreover, in making the tests, the condition of equal colour intensity was approached first from one direction and then from the other.[7]

From the above results, it appears that the double oxalate of titanium and potassium is very desirable as a starting material for preparing a standard solution of titanic sulphate.

The bleaching action of the small amount of ammonium sulphate (0.08 gram per 10 cm_3 of solution) introduced in the preparation of Soution 1 is not noticeable. In fact a like amount of the salt was purposely introduced into Solution 2; and the comparison made as above. Table II gives the results of these experiments.

TABLE II.

Experiments No.	Grm. TiO_2 per cm_3 of Solution 1
7	0.000971
8	0.001010
Average ...	0.000991
Found gravimetrically...	0.000992

In conclusion, several advantages may be claimed for the use of potasium titanium oxalate as an initial substance from which to prepare a standard solution for use in colorimetric work :

1. Platinum dishes are not needed; recrystallization of the salt and decomposition of the organic matter being carried out in Pyrex glassware.

2. The repeated treatments of potassium fluotitanate with sulphuric acid consume several hours; but, by using the double oxolate, 20 minutes suffices for the complete removal of the presumably interfering oxalate radical.

3. Potassium fluotitanate, the former salt being used to a considerable extent in commerce (for the fixation of color on fabric, etc.). A quantity of the double oxalate containing a given amount of titanium costs less than a quantity of the fluotitanate containing an equal amount of the same element.

Johns Hopkins Chemical Laboratory, Baltimore, Maryland.

[7] Cf. Wells, J. Am. Chem. Soc., 33, 504. 1911.

THE SECOMETER. A DEVICE FOR MEASURING THE RATE OF EVAPORATION OF LIQUIDS.

By G. LINDESAY CLARK, B.Sc., M.M.E.

The instrument depends on the principle that, over a short period, the surface of a porous substance from which a liquid is evaporating receives the same amount of heat by conduction, convection, and radiation as it loses in the latent heat of the evaporating liquid. If, then, the amount of heat being received by a surface can be measured, the rate of evaporation can also be obtained. The Kota thermometer is also based on this principle differently applied.

The instrument consists essentially of a thermometer with a sliding scale, which is divided by three pointers into two equal parts which may be spaced so as to cover a distance of, for example, 5° of the thermometer scale. The instrument is calibrated so that the amount of heat required per unit area of the bulb to raise the meniscus 1° is known. The method of using the instrument is as follows :—

The slide is first set so that the central pointer is at the temperature of the evaporating surface. The thermometer is cooled by any convenient means so that the meniscus is several degrees below the lowest pointer. The thermometer is then placed near the evaporating surface, when the meniscus begins to rise and the time taken for it to rise from the lowest to the top pointer is measured. From this and the calibration results the amount of heat received per unit area of the bulh at the mean temperature per minute can be calculated, and by dividing by the latent heat of evaporation of the liquid at the surface temperature the amount of liquid evaporated per unit area per minute can be got.

For example, if

C = Heat required by the bulb to raise the meniscus from the bottom to the top pointer.
A = Area of surface of bulb.
L = Latent heat of the liquid at the temperature of the wet surface.
t = Time taken for the meniscus to rise from the bottom to the top pointer.
E = Rate of evaporation in grammes per square centimetre per minute.

$$E = \frac{C}{A \times L \times t}$$

If the constant of the instrument be represented by K,

$$K = \frac{C}{A} \text{ and } E = \frac{K}{L \times t}$$

The rate of evoporation of liquids from porous materials is controlled by one of two phenomena, *viz.*:

(*a*) Evaporation from the surface of the material.

(*b*) Diffusion of the liquid from the interior to the surface of the material.

For materials in which the former process is the controlling factor the surface temperature is readily obtained, as it is the "wet bulb" temperature. In using the secometer the central pointer of the scale is set at the "wet bulb" temperature, which is an easy and convenient method of working.

For materials in which the latter process controls the rate of evaporation, the surface temperature will gradually increase, during the evaporating period, as the distance that the liquid has to diffuse from the interior of the substance to the surface increases.

The surface temperature may be obtained at any moment by specially constructed thermometer with a flat bulb, or by a pyrometer, and in making secometer readings, the central pointer is set to this temperature.

The secometer automatically takes into account all the varying factors which control the rate of evaporation, *viz.*, the temperature, the velocity of the air, and the vapour pressure of the liquid in the air.

It might be expected that the roughness of colour, etc., of the evaporating surface would influence the rate of evaporation. This may be so, and, if necessary, the surface of the bulb of the secometer may be made a convenient shape and be covered with a veneer of the substance being dried. In the tests given below, the surface of the bulb was glass, no covering being used.

Tests.

The instrument used in the tests was an alcohol thermometer calibrated by the Physics School of the University of Melbourne. A factor of 0.46 was obtained for the instrument when the rate was calculated in calories per square centimetre of evaporating surface per minute.

The instrument was tested against the rate of drying of wet leather. The leather used was black horsehide, which had been freed of most of its water by drawing through rollers. Test squares of leather, from 16 to 18 cm. square, were suspended in a frame. The leather was weighed and suspended in the drying stove for a measured time. It was then removed and weighed again, and from the loss of weight the rate of evaporation in grammes of water, per square centimetre per minute was calculated. These results were compared with the mean of successive readings of the secometer taken in the vicinity of the test squares during the drying period.

The tests were made under various conditions of humidity and air velocity with the results given below.

September and October, 1927.

Test No.	Temperature of air in°F Dry bulb	Wet bulb	Diff.	Drying rate in grm. per sq. cm. per min. By loss of weight of leather	By secometer	Remarks.
1	79	65.6	13.4	.00020	.00024	Forced draught air velocity low, but not measured.
2	85	66.2	18.8	.00022	.00025	do.
3	90	66	24	.00028	.00033	do.
4	90	68	22	.00038	.00049	do.
5	91	70	21	.00031	.00048	do.
6	92	69.8	22.2	.00050	.00058	do.
7	95	75	20	.00056	.00058	do.
8	130	88	42	.00074	.00070	Natural connection in closed room.

In the tests the assumption was made that surface evaporation was the controlling factor, and the readings of the secometer were made with the central pointer at the " wet bulb " temperature. It is practically certain that this assumption was justified in these tests, except possibly in Test No. 5, as several checks of surface temperature of the leather were made and it was found to correspond to the ' wet bulb " temperature.

The agreement, taking into account the difficulty of heat measurements, is very good.

Commercial Use.

Many substances are very sensitive to drying conditions—for example, leather, porcelain, timber, etc., and careful control of the drying stoves is necessary. The usual procedure is to experiment in small driers until the maximum permissible drying rate is obtained, and then to try to obtain similar conditions in a larger drier. This is not easy, since up to date no means of telling the effect of the daily variations of humidity or of the air velocity except by test specimens is known. These factors are taken into account by the instrument. If secometer readings are taken in the experimental stove, then the working of the commercial plants can be frequently and easily checked against the optimum readings in the experimental plant and the quantity and quality of the air regulated from time to time as found necessary. The instrument is so simple that it can be used by workmen.

For most practical purposes the secometer may be used by setting the central pointed at the " wet bulb " temperature. It then measures the " evaporating power " of the air on a " wet " surface in which surface evaporation is the controlling factor, and takes all the factors into account, *viz.*, air velocity, humidity, and temperature. In general this will be sufficient for commercial control since it gives the relative evaporating power of the air, taking into account the essential factors, although with substances of the second class it does not measure the actual drying rate of the substance. If this is required, the surface temperature of the substance must be obtained.

For substances, such as fruit, etc., it is obvious that results may be calculated in grammes of water evaporated per pound of substance dried instead of per square foot of area if this proves to be more convenient.

(*Australian Institute of Mining and Metallurgy.*)

SUPERPHOSPHATE INDUSTRY IN JAPAN.

In Japan calcium superphosphate was made at first by the late Dr. Jokichi Takamine. He organised the Tokio Jinzo-Hirio K.K. in 1887 and erected a manufacturing plant at Kamayabori near Tokio. Though the plant was fired at the earthquake of Tokio and its neighbourhood in 1923, the Dainippon Jinzo-Hirio K.K., the biggest producer of superphosphate, is the successor of that company.

When superphosphate was made at first, our farmers did not know its fertilising value, and therefore its demand had been very poor for a long time. But at the Chino-Japanese and Russo-Japanese war, the supply of soy-bean cake from Manchuria was stopped, and so the demand of chemical fertilisers was suddenly increased. Then during the last World-War, accompanying with the development of all industries, this industry also made very remarkable strides, and thus at present there are 25 works in total, producing more than 90,000 tons of superphosphate annually.

Superphosphate Producers in Japan.

Name.	No. of Works.	Productive Capacity of 50° Bé H_2SO_4 used for superphosphate per day
Dainippon Jinzo-Hirio K.K.	11	920 long tons
Taki Seihijo K.K.	1	310
Sumitomo Seihijo K.K.	1	220
Rasato Rinko K.K.	2	220
Osaka Arukari Tochi K.K.	2	140
Konoshima Jinzo-Hirio K.K.	1	95
Nitto Riuhi K.K.	1	80
Teikoku Jinzo-Hirio K.K.	1	64
Niigata Riusan K.K.	1	63
Nippon Hiuso K.K.	1	58
Taiwan Hirio K.K.	1	28
Toyo Jinzo-Hirio K.K.	1	non
Osaka Guano Seihijo K.K.	1	non.
Total	25	2,198

The total capital invested in this industry is estimated at about Y40,000,000, and its productive capacity attains to about 1,400,000 tons per year. But the consumption of superphosphate in Japan is less than 1,000,000 tons and therefore the Asso-

ciation of the superphosphate manufacturers always must cut off their capacity up to about 30 per cent. in order to regulate their production.

PRODUCTION OF SUPERPHOSPHATE IN JAPAN.

	long tons		long tons
1922 ...	585,000	1926 ...	774,000
1923 ...	499,000	1927 ...	920,000
1924 ...	584,000	1928 ...	926,000
1925 ...	663,000	1929	ca. 950,000

In Japan, two kinds of superphosphates which contain 19.5 per cent. and 15 per cent. water-soluble P_2O_5 respectively, are most widely manufactured, and 80 per cent. of the total production is consumed as superphosphate itself, the remainder being used for manufacturing complete fertilisers.

Since Japan is rich in pyrites, the supply of sulphuric acid is abundant and about one-half of its total output is consumed for superphosphate industry. While Japan is not favoured in production of phosphate rock and among the total demand of 550,000 tons, only 60,000 are produced from the Angaur Island, the remainder being imported from North America, North Africa and the Islands in the South Sea.

Recently the manufacture of phosphoric acid by the decomposition of phosphate rock with sulphuric acid is economically established, and phosphoric acid is used for the manufacture of double superphosphate and other high-grade superphosphates, while the by-product gypsum is used for cement and plaster industries. In America and Europe, the volatilisation process is also carried out commercially, but in Japan this process does not yet get rid of the experimental stage.

THE SALTERS' INSTITUTE OF INDUSTRIAL CHEMISTRY.

The following awards for the year 1930-31 have been made by the Salters' Institute of Industrial Chemistry and approved by the Court of the Salters' Company.—

Fellowship Renewed.—D. D. Hodge, of the Imperial College, London.

Fellowships Awarded.—G. H. Abbott, Jesus College, Oxford; D. J. Branscombe, University College, Exeter; H. G. Simpson, East London College; and J. Hofton, Caius College, Cambridge.

The Salters' Institute has also awarded 102 Grants-in-Aid to young men and women employed in chemical works, to facilitate their further studies.

THE TREATMENT OF MIXED CONCENTRATES FROM BASE-METAL SULPHIDE ORE.

By W. E. HARRIS.

Electro-metallurgist, Base Metals Extraction Company, Ltd.

Leaches were made on roasted bulk concentrates obtained from Amulet ores; this concentrate assayed 32.02 per cent. zinc, 6.8 per cent. copper, enriched with a roasted copper precipitate containing 72 per cent. copper which brought the copper content of the ore charge to approximately 12 per cent.

The leaching solution consisted of a 21 per cent. sulphuric acid liquor; after leaching and precipitating the iron and silica the resulting solution contained 8.84 per cent. zinc, and 3.09 per cent. copper. This solution was acidified with sulphuric acid to 1 per cent., and electrolysed in a series of cells (cascade) using insoluble lead anodes. About 75 per cent. of the copper was deposited out before any signs of deterioration or "burning" was seen in the deposit and the resulting outflowing solution ran 9 per cent. zinc, 0.8 per cent. copper, and 6.5 per cent acid.

The experiment was repeated with a synthetic solution made up from leach liquors enriched with copper sulphate, the head solution running 8.58 per cent. zinc, 4.8 per cent, copper, 1.0 per cent. sulphuric acid.

This solution was electrolysed as before with lead anodes until signs of "burning" occurred, the resulting solution assayed, zinc 9.2 per cent., copper 0.82 per cent., acid 5.97 per cent., being equivalent to a deposition of 83 per cent. of the copper present in the original solution. This copper assayed (electrolytic assay) 99.48 per cent. The current density of the top cells never exceeded 10 amperes per square, foot, and of the lower cells 5 amperes per square foot.

In a large-scale plant where the effect of the solution flow (which would be much greater in proportion) would be felt, the copper content could doubtless be lowered to 0.5 per cent. copper in solution.

The treatment of the residues followed the outlines of the German patents known as the Waelz process, which consists of mixing the leach (or other residues) with a reducing agent such as anthracite or coke dust and subjecting to great heat. This is done in a long, revolving furnace whereby the mixture is carried forward by each revolution of the furnace, and has but little depth.

This furnace was 30 inches long, by about 12 inches in diameter, lined with firebrick

so as to leave an inside diameter of about 6 inches. Owing to the small size of the furnace considerable difficulty was experienced in keeping the ore charged in the furnace, and in getting the required 1,100° to 1,200° C., as the air blast was so strong that it blew the charge back and much of the fines and the coal dust was blown into the flues. However, the greater part of this difficulty was eventually overcome.

The object of the experiments was to show that the zinc (and lead if any) could be volatilised and removed as the zinc oxide (and lead oxide).

The residues treated came from Amulet ore and leaches and assayed 18.8 per cent. zinc. 2.95 per cent. copper, 0.14 ounce gold, and 4.24 ounces silver.

This was mixed with varying amounts of anthracite dust and in some cases powdered limsetone. The resultant residues ran 0.55 per cent. zinc, 3.78 per cent. copper, 0.18 ounce gold, and 3.79 ounces silver; and the zinc oxide produced ran 56.45 per cent. zinc with less than ½ per cent. copper and equalled an elimination of 97 to 98 per cent. of zinc from the residue.

A volatilisation of some of the silver took place but as almost identical gold and silver contents were found in the flue dust, it was concluded that these were mechanical losses due to the heavy air blast before mentioned.

These losses would not occur in a commercial furnace, which is from 120 to 140 feet long and has only a natural draught. Again the zone of maximum temperature in our experiment occurred approximately two-thirds the length of the furnace from the point of feeding, and one-third from the source of heat—a gas blast. In a commercial furnace once the reaction starts, the zone of maximum temperature is only one-fifth of the distance from the source of feed and there is no blast, so that the mechanical loss of fines is small; this can be collected in a special chamber and returned to the furnace.

However, the object of the experiments was to prove the volatilisation of the zinc and the results show that this is possible.

The resultant residue containing the copper and the precious metals was a sinter of an open granular nature and of a size that should lend itself to smelting for the recovery of the copper as a matte. Some small-scale tests seemed to point to the possibility of recovering the copper direct as metal, but with the varying sulphur contents it is probable that a matte would have to be formed.

GENERAL NOTES

NEW COMMERCIAL DIPLOMATIC POSTS.

Following the announcement in the House of Commons in March last by Mr. G. M. Gillett, Parliamentary Sec., to the Department of Overseas Trade, that 8 new posts were to be created in the Commercial Diplomatic Service, over 1,100 applications were received by the Civil Service Commissioners. They after undertaking, a preliminary review of the claims of all the candidates, passed on the names of over 70 of them for further consideration by a selection Board, consisting of a member of Parliament three business men and five representatives of Government Departments.

The appointments are now notified of Commercial Diplomatic representatives in Argentina, Brazil, China, for service in Manchuria and Columbia, Egypt, Finland, Persia, and Switzerland.

Two new Trade Commissioners Post have been created in Montreal and Durban.

MARKET FOR DISINFECTANT, INSECTICIDES AND ANIMAL DRESSINGS IN TURKEY.

A confidential report on the market for disinfectant, insecticides and animal dressings in Turkey, has been prepared by the Department of Overseas Trade from information furnished by the Commercial Secretary, His Majesty's Embassy, Istanbul, and issued to firms whose names are entered on its Special Register.

Firms desirous of receiving a copy of this report together with particulars of the Special Register service of information and form of application for registration should communicate with the Department of Overseas Trade, 35, Old Queen Street, London S.W.1.

TRADE DEPRESSION.

The end of the international trade depression is not yet in sight, but we cannot be very far from the bottom. By comparison with other countries British trade has held up surprisingly well, though, having regard to the disorganisation which the fall in prices of primary products has occasioned in the raw material and food producing areas of the world, our export activities have been seriously curtailed.

Owing to the magnitude of her raw material commitments, the United States continues to exercise a dominating influence on the prices of many important raw materials

and, while it is quite possible for international trade to revive without American participation or price stability, a condition of maladjustment in that country cannot fail to have a delaying effect.

As foreshadowed in our last quarter's forecast, American producers have had to pay for their premature optimism earlier in the year. But while there are signs that they are at last according proper recognition to the serious nature of the present crisis, the view that economic laws are susceptible to influence by mass propaganda and advertising, unfortunately still continues to prevail in many quarters.

CITY AND GUILDS OF LONDON INSTITUTE.

The Council of the City and Guilds of London Institute have conferred the distinction of Fellow of the Institute (F.C.G.I.) upon the following :—

F. H. Denton, Fellow American I.E.E.
A. H. Dykes, M.Inst.C.E., M.I.E.E., M.Cons.E.
W. H. Heller, B.Sc. (London).
E. M. Rich, B.Sc. (London), F.C.S.
F. F. Renwick, F.I.C.

The Fellowship is conferred by the Council upon those who, having obtained the Associateship of the Institute and spent at least five years in actual practice, produce evidence of having done some original and valuable research work, or of having otherwise contributed to the advancement of the industry in which they are engaged.

DYESTUFFS (IMPORT REGULATION) ACT, 1920.

The following statement relating to applications for licences under the Dyestuff (Import Regulation) Act, 1920, made during July has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee.

The total number of applications received during the month was 698, of which 575 were from merchants or importers. To these should be added 5 cases outstanding on the 30th June, 1930, making a total for the month of 703.

Of the total of 703 applications received, 660 or 94 er cent were dealt with within 7 days of receipt.

FIELD WORK OF THE GEOLOGICAL SURVEY OF CANADA, 1930.

The Geological Survey Branch of the Dominion Department of Mines has fifty-eight parties engaged in field work this year at different points throughout the length and breadth of Canada. The Director, Dr. W. H. Collins, states that thirty-six of these, and four sub-parties, are engaged in geological work, thirteen are making topographical surveys, three are investigating geophysical methods of prospecting, and two are collecting specimens for the National Museum.

Although the work is widespread, there are several areas on which effort is being concentrated because of their special interest at the present time from an economical point of view.

The granitic rocks of the Coast Range of western British Columbia and Yukon have been found to be the source of valuable mineral deposits occurring in adjacent intruded rocks. To assist in the discovery of additional deposits the Survey is mapping the eastern contact of the Coast Range intrusives with older formations at three different localities.

Another extensive area in which large deposits of metallic minerals have been found and which are attracting much attention is that which is underlain by rocks of Precambrian age in northern Quebec, northern Ontario, northern Manitoba, northern Saskatchewan, and the North-West territories. Parties are engaged at a number of points throughout this area in studying the geology and the conditions of mineralization and in acquiring information to enable them to show on maps the distribution of the formations carrying minerals of value. Work is being done at Chibougamau and Opemiska lakes in Quebec, near Michipicoten and at Sudbury in Ontario, in the Cold Lake area, Manitoba, in northern Saskatchewan, and on Great Slave lake and the west coast of Hudson Bay of the North-West territories.

FOOD PRODUCTION IN ITALY.

As has been explained in previous reports on Italy, the country is still mainly an agricultural one and poor in mineral resources, and every effort is directed, therefore, to increase the area and output of food-producting products so that not only can the large sums spent on the import of wheat and other foodstuffs be reduced, but also that national products, such as fruit and wine, can be grown in such quantities as will permit of a surplus for export, whereby industry's requirements from abroad in raw materials can be paid for. Therefore, it will be seen

that in the forefront of the Government's programme stands the question of assistance to agriculture and the fuller employment and expansion of natural resources.

Hence, the interest shown in the "Battle of the Grain," more extensive cultivation of land, reclamation and irrigation schemes, and a concentrated activity in hydro-electric undertakings.

Through success in the former, it is hoped to save large sums of money on the import of foodstuffs, while through the provision of hydro-electric power industry can expand together with a reduction of coal imports, a commodity which is an important source of revenue to other countries, but the necessity for which costs Italy many millions of lire each year. As a matter of fact, the actual imports of coal are increasing, but through the development of hydro-electric schemes new sources of industry are being created which in turn enrich the country and again permit of the payment for larger coal imports.

BUNEOS AIRES BRITISH EMPIRE EXHIBITION, 1931.

Owing to the greatly increased importance now assumed by the British Empire Exhibition to be held at Buenos Aires in March and April 1931, His Majesty's Government have decided to treble the sum to be expended on their official participation in the Exhibition. This large increase will allow a considerable part of the impressive British Government Exhibits now being shown in the Antwerp Exhibition to be sent out and adequately displayed at Buenos Aires. The management of the Buenos Aires Exhibition have placed one of the finest buildings in their grounds at the disposal of the British Government, and the decorations of this hall and the arrangement of the Exhibits will be in the hands of the Department of Overseas Trade. Those who remember the Wembly Exhibition will be interested to learn that one feature of the Government pavilion at Buenos Aires will be the large "Map of the World" with numerous minute models of ships travelling, apparently under their own guidance, from port to port across seas of real water.

The desire of British manufacturers to exhibit in the Trade Sections of the Exhibition has been so great that it has been found necessary to provide more than double the covered space originally designed—and although the grounds and buildings cover more than twenty-five acres it will be difficult to fit in all who wish to participate.

SULPHATE OF AMMONIA PRODUCTION IN CANADA.

The Dominion Bureau of Statistics at Ottawa reports that the production of Ammonium Sulphate in Canada during 1929 amounted to 34,141 tons valued at $1,293,953 as compared with 28,090 tons worth $1,108,744 in 1928. All of the ammonium sulphate made in Canada is produced as a by-product of the coke and artificial gas industries.

A large part of the Canadian production is exported to foreign countries for use as a fertiliser. In 1929 exports totalled 24,480 tons worth $909,510 as compared with 13,632 tons valued at $591,696 in 1928. The principal countries of destination with the quantities and values of Canadian export to each were as follows:—Japan, 10,095 tons worth $375,020; United States, 6,857 tons worth $220,734: Hong Kong, 2,155 tons at $93,783; Barbados, 1,909 tons at $81,460; China, 1,304 tons at $50,434; other British West Indies, 822 tons at $33,871; British Guiana, 546 tons at $23,,158; and Porto Rico, 302 tons at $13,025.

Some ammonium sulphate is imported into Canada. During 1929 about 1,723 tons worth $80,019 were brought into Canada; the bulk of this came from the United States. In 1928 the imports were 3,510 tons worth $174,899.

These figures show the rapid increase in the production of sulphate of Ammonia in Canada during recent years.

DEATH OF ELDEST SON OF THE LATE SIR WILLIAM CROOKES

(FOUNDER OF "THE CHEMICAL NEWS.")

On August 12, 1930, Bernard Humphrey Crookes, beloved husband of Edith and eldest son of the late Sir William Crookes, O.M., and F.R.S.

STERILIZING OUTFITS AND N_2O GAS APPARATUS, EGYPT.

The Commercial Secretary to the Residency, Egypt, reports that the Ministry of the Interior, Egypt is calling for tenders, to be presented in Cairo by the 18th October, for the supply of sterilizing outfits and gas apparatus.

Firms desirous of offering such apparatus can obtain further particulars of this call

for tenders upon application to the Department of Overseas Trade, 35, Old Queen Street, S.W.1. Reference number A.X. 10,018 should be quoted.

NOTICES OF BOOKS.

Drug and Chemical Guide Book. Eighth Edition. Pp. 938. Bureau of Economic Chemistry, Incorporated, 25, Spruce Street, New York, U.S.A. 1930.

In this Red Book will be found detailed particulars and valuable information concerning the Drug and Chemical Industries of America.

It is divided into five parts, each conveniently arranged. On referring to the book the reader can ascertain immediately full particulars concerning products, chemical formulæ, uses, names and addresses of makers, etc.

Part I gives the combined catalogue of firms, arranged alphabetically, showing complete list of chemical and drug products, manufactured or handled by each.

Part II. Buying Guide for chemicals, drugs, dyes, essential oils, aromatic chemicals, tarstuffs, pigments, fatty oils and allied products with names of suppliers under each item. The Chemical and Physical data, grades types and sizes of containers and shipping regulations.

Part III. Directory of Chemical Drug and allied industries of the United States, together with street adddesses and telephone numbers.

Parts IV and V deal with packing container, shipping, price data, and trade information.

Buyers and all users of chemicals and drugs should procure a copy of this valuable book, in which will be found useful and reputable information.

NEW PUBLICATIONS.

Treadwell & Hall's *Analytical Chemistry.* In two Volumes. Based on the German Text of F. P. Treadwell ,Ph.D., late Professor of Analytical Chemistry in the Polytechnic Institute of Zurich. Translated. Enlarged and Revised by William T. Hall, S.B., Associate Professor of Chemistry, Massachussets Institute of Technology. Seventh Edition. Chapman & Hall, Ltd., 11, Henrietta Street, London. W.C.2.

Colloid Chemistry. Principles and Applications. By JEROME ALEXANDER, M.Sc., Consulting Chemist and Chemical Engineer. Fellow Amer. Assn. for the Advance of Science and Amer. Inst. of Chemists; Member Amer. Inst. of Chem. Engineers and Amer. Inst. Mining and Metallurgical Engineers. Chapman and Hall, Ltd., 11, Henrietta Street, London, W.C.2.

Forthcoming Events.

THE INSTITUTE OF METALS.

The autumn meeting of the Institute will be held at Southampton from September 9 to 12. The ninth autumn lecture will be delivered by Professor D. Hanson, D.Ss. (Vice-President), in the Chantry Hall, Chapel Road. The subject will be "The *Use of Non-Ferrous Metals in the Aeronautical* Industry." Only members, student members, and applicants for membership (with their ladies) will be entitled to participate in the Southampton meeting (except that visitors may attend the reading of papers). For the convenience of applicants for membership, who are desirous of attending the meetings, a special election is being arranged in connection with which membership application forms should be received by the Secretary, The Institute of Metals, 36, Victoria Street, London, S.W.1, not later than noon, on Thursday, August 28.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

23,124.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of heterocyclic compounds. July 31.

23,251.—I. G. Farbenindustrie Akt.-Ges. —Manufactnre of stable reduction compounds of vat-dyestuffs. August 1.

Specifications Published.

300,512.—Soc. L'Air Liquide, Soc. Anon. Pour L'Etude et L'Exploitation des Procedes G. Claude.—Manufacture of oxygenated organic compounds.

332,623.—I. G. Farbenindustrie Akt.-Ges. Manufacture and production of condensation products containing nitrogen.

882,571.—Harrison, C. F. R., and Imperial Chemical Industries, Ltd.—Produc- of hydrogen.

Printed copies of the full published specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2., at the uniform price of 1/- each.

Abstract Published.

330,537.—Acetic anhydride.—I. G. Farbenindustrie Akt.-Ges., Frankfort-on-Main, Germany.

Acetic anhydride is produced by passing acetic acid vapour over a catalyst comprising boron phosphate and an alkali phosphate or other compound of an alkali metal at 400-700° C. When a deposit of carbon appears, the catalyst is regenerated hy ignition in air. The catalyst is prepared by adding boron phosphate to a solution of alkali phosphate, borate, carbonate or hydroxide, evaporating the whole to dryness, and calcining. In the examples, the catalysts are prepared from boron phosphate and acid sodium ammonium phosphate, microcosmic salt, borax and sodium hydrate respectively. Another catalyst mentioned is prepared from boron phosphate, lithium *m*-phosphate, and sodium *m*-phosphate.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

SOL-I-SOL.

514,183.—Chemical substances used in manufactures, photography or philosophical research, and anti-corrosives. — Anglo-American Oil Co., Ltd., 36, Queen Anne's Gate, Westminster, London, S.W.1. August 6. (Associated.)

LENOCAL.

513,681.—All goods in Class 1 which includes chemical substances used in manufactures, photography, or philosophical research, and anti-corrosives.—I. G. Farbenindustrie Aktiengellschaft. Mainzerlandstrasse 28, Frankfort-on-Main, Germany. August 6. (Associated.)

SOLIM.

510,987.—Chemical substances being compounds for the removal of hardness from water.—United Water Softeners, Ltd., Aldwych House, Aldwych, London, W.C.2. August 6. (By consent.)

511,837.—A label device illustrating a Shell and the words SHELL BRAND.—Chemical substances used in manufactures, photography or philosophical research and anti-corrosives, all being goods for export only, but not for export to the Irish Free State.—The Asiatic Petroleum Co., Ltd., St. Helen's Court, Great St. Helen's London, E.C.3. August 6. (Associated.)

GRAMMAR OF LOGIC.

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BRICK KILN PATENT FOR DISPOSAL.

Mr. V. Lastovicka, of the Japan and China Trading Co., 56, Rasin Embankment, Prague, Czechoslovakia, is open to receive offers for the exploitation of his patented "Tunnel" Brick Kiln Construction in Great Britain and Dominions and Colonies.
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NOTICE TO AUTHORS & CORRESPONDENTS.

Contributions for publication either as original articles or in the correspondence columns are welcomed by the Editor of *The Chemical News.*

They must be accompanied by the contributors' full names and addresses, not necessarily for publication, but as an indication of good faith. If a reply is needed or if it is desired that a manuscript which is not accepted for publication be returned, a stamped addressed envelope should be enclosed.

No notice can be taken of anonymous letters.

SEPARATION OF MANGANESE FROM COBALT BY AMMONIUM PERSULPHATE.

By TAKAYUKI SOMIYA.

The complete separation of manganese from cobalt is very important when the bismuthate method is applied to the determination of manganese in cobalt steel. Therefore the author studied the amount of cobalt that was carried down with the manganese oxides precipitated by the following methods and the amount of manganese that was left in the filtered solution.

The precipitation took place with 1 g. of ammonium persulphate in 200 cc. of ammoniacal solution (A), or nearly neutral solution (B), which contained 0.0078g. of manganese, 0-1g. of zinc and 0-0.15g. of cobalt. In the procedure of (A) 10g. of ammonium chloride and 10 cc. of concentrated ammonia were added. In that of (B), a very small amount of suspended zinc oxide in water was added and the solution was filtered before the addition of ammonium persulphate. The results of the experiments are as follows:—

1. Manganese oxides which were free from cobalt could not be precipitated with ammonium persulphate in ammoniacal or neutral solution and there was no difference between the proceedures of (A) and (B) in the separation of manganese from cobalt in this respect.

2. In a ammonical solution containing considerable amounts of zinc and cobalt, it was difficult to precipitate manganese oxides in such coarse form as could be easily filtered off and therefore manganese was liable to be lost in the filtrate. But it was possible to precipitate manganese completely, provided the precipitation was repeated by adding ammonium persulphate and boiling until no preciptate was formed.

3. When the precipitate took place in a solution containing considerable amount of zinc by the method of (B), the manganese oxides contained a very small amount of cobalt and could be easily filtered off. But there was a fear that manganese might remain in the filtrate, because the solution became acid owing to the decomposition of ammonium persulphate.

4. The effect of zinc was more remarkable in the case of (B) than (A). In the former case the amount of manganese left in the filtrate and that of cobalt carried down with the manganese oxides, were markedly reduced by the presence of zinc ion.

Institute of Techno-Analytical Chemistry,
Tokyo Imperial University.

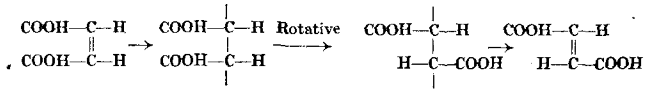
STUDIES IN GEOMETRICAL INVERSION.—A NOTE ON THEORIES TO EXPLAIN GEOMETRICAL INVERSION.

By Panchanan Neogi, M.A., Ph.D.,
Professor of Chemistry, Presidency College, Calcutta, India, and
Sunil Kumar Mitra, M.Sc.

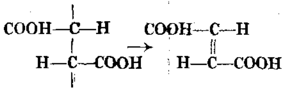
In order to explain geometrical inversion it would be necessary (1) to determine its mechanism, and (2) to examine the relationship of geometrical isomers as regards their energy content.

As regards the mechanism of geometrical inversion, principally three theories, based on the Van't Hoff model, are prevalent, *viz.* (1) Wislecenus' theory of the formation of additive ethane derivatives; (2) Liebermann's explanation, based on the alteration of the structure of the carboxyl group; and (3) Stewart's hypothesis of formation of intermediate cyclic compounds. Wislicenus' theory of the formation of intermediate additive derivative, during inversion by water, halogens or halogen acids, has been shown to be untenable by Skraup, Anschutz, Fittig, and others as these intermediate compounds are perfectly stable at the temperature at which inversion takes place. Liebermann's explanation is not applicable to geometrical isomers, which do not contain any carboxyl group. Stewart's theory is open to the objection that apart from the probability of the formation of cyclic compounds, the latter, if formed, would be too stable to break down spontaneously.

Cohen (Organic Chemistry for Advanced Students, Vol. II, Chap. Stereo-Chemistry, has given the following diagrammatic representation of the transformation of maleic to fumaric acid based on the " rotation hypothesis " but without supposition of the formation of additive derivatives :—

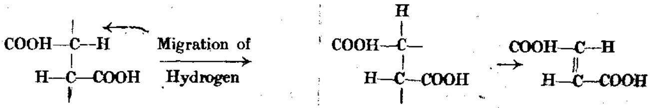


This representation, however, is erroneous. It looks well on the plane of the paper, but when tried with tetrahedron models it would be seen that the last stage, *viz.* :—

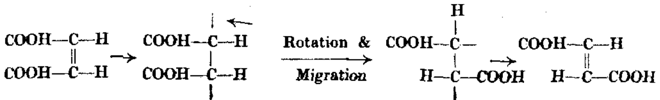


was an impossible one, the double bond being not formed.

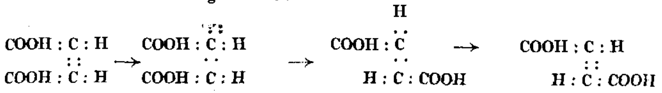
It is the purpose of this note to show that a satisfactory explanation of geometrical inversion can be obtained by a further modification of the " rotation hypothesis " and without the supposition of the formation of intermediate additive compounds. Our hypothesis is that along with the rotation of one of the carbon atoms through 180° a hydrogen atom, or the most mobile group in the absence of hydrogen, migration to one of the free bonds so that the last stage in the case of maleic acid is represented as :—



A trial with tetrahedron models will at once convince of the satisfactory nature of this explanation. Wislecenus himself once suggested the wandering of a hydrogen atom. The series of transformation will now be represented as :—

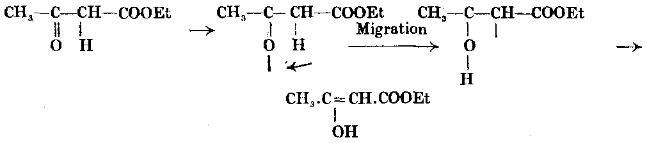


On the electronic hypothesis the transformations would be represented in the following manner :—



It is to be noted in this connection that both according to Lewis-Langmuir theory of octets, as well as Bohr's theory of atoms the electrons, though mobile, arrange themselves at the corners of a tetrahedron, and therefore the representation of the several stages noted above would mean, that if momentary snapshots be taken the latter would represent a series of pictures of the actual dispositions of the atoms and the electrons on the basis of the tetrahedral grouping of electrons associated with two carbon atoms. It is further to be noted that if both the hydrogen atoms migrate to the two vacant bonds the original maleic acid is reformed, and it is when under the existing experimental conditions, only one of the hydrogen atoms migrates that the fumaric acid is obtained.

The migration of a single hydrogen atom or indeed of other mobile groups is not an unknown phenomenon. The migration of a hydrogen atom exists, as is well known, in the case of the transformation of tautomerides like acetoacetic ester which takes place in the following successive stages :—



The migration of other mobile radicals is exemplified in the following amongst many other examples :—

(1) The transformation of pinacone (Fittig), *Annalen*, 1860, CXIV, 56) in which the methyl radical migrates from one carbon atom to another.

$$\begin{matrix} CH_3 \\ CH_3 \end{matrix} > C(OH).C(OH) < \begin{matrix} CH_3 \\ CH_3 \end{matrix} \longrightarrow (CH_3)_3.C.CO.CH_3 + H_2O$$

(2) The conversion of isoacetophenone ethyl ether to phenyl propyl ketone (Claisen, *Ber.*, 1896, XXIX, 2931)

$$C_6H_5C(OC_2H_5):CH_2 \longrightarrow C_6H_5COCH_2C_2H_5$$

(3) Conversion of alkyl isocyanides to cyanides at high temperatures (Wade, *Trans. Chem. Soc.*, 1902, LXXXI, 1596).

This theory of geometrical inversion is easily applicable to citraconic acid which contains one hydrogen atom which migrates, but in view of the replacement of the other hydrogen atom of maleic acid by a methyl radical, the transformation of citraconic acid to mesaconic acid is not so readily effected owing to the greater heaviness of the molecule as has been demonstrated in the experimental part of this work.

Other pairs of geometrical isomers like stilbene and isostilbene; crotonic and isocrotonic acids; tiglic and angelic acids; oleic and elaidic acids; cinnamic and allocinnamic acids; and other halogen aryl alkyl derivatives (like dimethyl dichloro, dibromo, diiodo ethylenes) contain at least one hydrogen atom which can migrate to the neighbouring free bond during rotation of one carbon atom. In the case of those compounds which have heavy molecules, it

is obvious that the transformations would be only more difficult. Then again in the case of those compounds in which both the hydrogen atoms are replaced by other radicals as in the case of tolane dichloride $C_6H_5CCl.CClC_6H_5$ or dimethyl maleic acid

$$\begin{array}{c} CH_3-C-COOH \\ \| \\ CH_3-C-COOH \end{array}$$

one of the chlorine atoms or methyl groups migrates to the vacant bond in the same manner as hydrogen does, though the transformation would be more difficult owing to the greater mobility of the hydrogen atom.

The theory of migration of one hydrogen atom or one other mobile radical to the vacant bond during rotation obviates the difficulty experienced in a possible theory of replacement of two radicals by each other in the fact that no bye-products would be formed as justly apprehended by Werner.

With a view to emphasise the hypothesis that geometrical inversion is occasioned by the rotation of carbon atoms owing to the instability of the double bond, we have coined a separate word "rotatory dynamic inversion" or shortly "*rotaversion*," to denote geometrical inversion and "*rotamerism*" to denote geometrical isomerism.*

Having explained the mechanism of geometrical inversion we now proceed to examine the relationship of geometrical isomers with reference to their energy content. We are of opinion along with Michael, Anschutz and Tanatar that geometrical inversion is analogous to the transformation of an ordinary labile to a stable substance and *vice versa* and takes place under similar circumstances. Maleic acid is converted to fumaric acid when heated in a closed vessel at 140°-145°, but when the latter is heated above 200° it is converted into maleic anhydride. This is analogous to the conversion of yellow to red phosphorus and *vice versa*. Hydrogen peroxide is unstable in comparison with water but dilute solutions can be kept unchanged under certain circumstances. If, however, a catalyst like colloidal platinum is added even dilute solutions of hydrogen peroxide are readily decomposed into water. The latter case is quite analogous to the transformation of maleic to fumaric acid by the addition of catalysts like halogen acids and others.

Of the geometrical isomers one variety is labile whilst the other variety is also stable but the labile variety is also stable within certain limits, and the stable variety is understood to be stable within its own range of stability and may be converted into the labile variety.

The following table summarises the conditions under which the labile variety is usually transformed into the stable one and *vice versa* :—

Agents	Conversion of labile to stable variety.	Conversion of stable to labile variety.
	Low frequency radiations	High frequency radiations.
	1. Heat. 2. Light.	1. Higher Temperature.
	3. Catalytic agents.	2. Ultra-violet rays.
	4. Exothermic reactions.	

The part played by exothermic reactions such as the action of sulphur dioxide on manganese dioxide in aqueous suspension in producting geometrical inversion (Neogi and Mitra, *Journ. Ind. Chem. Soc.*, 1929, 969) is analogous to that played by heat, light, and catalytic agents. Most of the labile varieties give higher heat of combustion as the following table will show :—

Maleic acid	...	...	331.3
Fumaric acid	...	...	317.6
Angelic acid	...	...	635.1
Tiglic acid	...	...	626.6
Oleic acid	...	...	2669.2
Elaidic acid	...	...	2664.3
Allocinnamic acid	...	...	1047.6
Cinnamic acid	...	...	1042.8

* Since writing the above our attention ha been drawn to the representation of th conversion of iso-crotonic acid to crotoni acid at 180° C., as given in Caven an Cranston's "Symbols and Formulæ i Chemistry," p. 112 (Edition 1929), i which migration of a hydrogen atom ha also been postulated. As this paper wa actually written in 1928 we are glad t have confirmation from an independen source. But Caven and Cranston sti represent the transformation of maleic t fumaric acid by HBr in the old manner formation of intermediate compoun which have been shown by Fitti Anschutz and others to be perfectly stab compounds.

In the case of citraconic and mesaconic acids, however, the difference is not lost and may come within experimental error. Stohmann (*J. Pract. Chem.*, 1892, XLV, 531) stated that the unstable thereo-isomer should give a larger heat of combustion than the stable variety. His observation was, however, based on the observation of the heat of combustion of a small number of stereo-isomers. But a labile variety *ipso-facto* possesses greater energy-content than the stable variety, so that ordinarily the former is converted to the latter and special agencies such as ultra violet rays or higher temperature can alone transform the stable to the labile variety by the supply of energy in a suitable form. The action of catalysts, exothermic reactions, heat and light, etc., initially increases the energy content of the labile variety thus activating it and increasing its velocity of transformation to the stable variety and necessarily by the liberation of a certain amount of energy. The molecules of the labile variety are thus activated and ultimately form the stable variety.

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METHOD OF ENHANCING THE SENSITIVENESS OF ALKALI METAL PHOTOELECTRIC CELLS.

By A. R. OLPIN.

(*Bell Telephone Laboratories.*)

A technique is described for sensitising alkali metal photoelectric cells to light by introducing on to the metal surface small amounts of dielectrics, as oxygen, water vapour, sulphur vapour, sulphur dioxide, hydrogen sulphide, air, sodium bisulphite, carbon bisulphide, etc., or some organic compound as methyl alcohol, acetic acid, benzene, nitrobenzene, acetone, etc., or some organic dye as tropaeolin, rosaniline base, eosin, cyanine, kryptocyanine, dicyanine, neocyanine, etc. The marked increase in electron emission from the cathodes of cells so treated is due primarily to an increase in response to red and infrared light. Vacuum sodium cells have been produced, yielding photoelectric currents as high as 7 microamperes per lumen of white colour temperature 2848°K and caesium cells yielding far greater currents.

The response of these cells is proportional to the intensity of the exciting light even for light of longer wave-lengths than that to which the cell responded before treatment.

Spectral response curves are similar for all sells using the same metal as cathode. These curves differ from the curves for the pure metal by the appearance of a new selective maximum at lower frequencies. This newly appearing maximum resembles the regular maximum for the untreated metal and is always separated from it by the frequency of a well-known line in the vibration-rotation spectrum of the dielectric molecules, usually the 1.5μ line so characteristic of oxygen-hydrogen, carbon-hydrogen or nitrogen-hydrogen linkages. The long wave limit shifts an amount agreeing with the separation of the maxima.

With a cell so designed that the cathode could be sensitised in a side chamber and then slipped into its proper place (thus keeping the anode free from light-sensitive materials), stopping potentials were obtained for electrons, liberated by monochromatic light, from a sodium cathode before and after treating it with sulphur vapour and air. For light of wave-lengths ranging from λ8500A to λ8000A falling on the treated cathode, the electron retarding potentials are found to vary linearly with the frequency of the exciting light, thus establishing the validity of Einstein's photoelectric equation for composite surfaces. From the slope of the straight line depicting this relationship, the value of Planck's constant h is found to be 6.541×10^{-27}, significant to three figures. An almost identical value is obtained for untreated sodium. The apparent stopping potentials, or voltages at which the photoelectric currents become zero are the same before and after the sulphur and air treatment. The voltage at which the current just saturates is always greater after treatment than before. This is a measure of the change in contact potential of the cathode due to the presence of the sulphur and air. Changes of approximately 0.8 volts are common.

The validity of Einstein's equation precludes the possibility of explaining the new maximum in the spectral response curve for a treated surface by a "Raman shift" of the incident light frequencies, even though the separation of these maxima is equal to certain well-known vibration-rotation frequencies of the dielectric molecules. It may be that the natural frequency of the alkali metal atom is diminished by the vibration frequency of the complex atom in which it is incooporated.

The Lindemann formula for the frequency of the selective photoelectric maximum $[2\pi\nu = (ne^2/mr^3)^{1/2}]$, primitive though it

seems in the light of modern theory, has always given values for the pure metals in close agreement with experimental determinations. The *n* term is determined by the valence of the substance, a choice of unity being used for the monovalent alkali metals corresponding to an electron revolving around a singly charged ion. A choice of 2, 3,—for divalent, trivalent—substances correspond to an electrons revolving around doubly, triply—charged oins. Under certain conditions the alkali metals manifest different valencies, such for instance as those exhibit in the oxide series Na_2O_2, Na_2O, Na_3O Na_4O. These compounds can be prepared in vacuum and are light-sensitive. Spectral response curves for such cells exhibit all the selective maxima called for by the Lindemann formula when the value of *n* is chosen to agree with the valence of the metal. Data are presented showing this condition to be general for the alkali metals, a maximum response to red or infra-red light being dependent upon the formation of a subvalent compound, as a suboxide.

. Attention is called to seemingly analogous phenomena in the fields of photo-electricity, photography, fluorescence and absorption.

SEVENTY YEARS AGO.

(From the Chemical News, Jan. 14, 1860.)

ROYAL INSTITUTION OF GREAT BRITAIN.

A course of Six Lectures (adapted to a Juvenile Auditory)consisting of Illustrations of the various Forces of Matter, i.e. of such as are called the Physical or Inorganic Force —including an Account of their Relations to each other; by M. FARADAY, *D.C.L., F.R.S., Fullerian Professor of Chemistry, R.I., Foreign Associate of the Academy of Sciences, Paris, &c.*

LECTURE II. (Jan. 3, 1860.)—*Gravitation —Cohesion.*

Do me the favour to pay me as much attention as you did at our last meeting, and I shall not repent of that which I have proposed to undertake. It will be impossible for us to consider the laws of Nature, and what they effect, unless we now and then give our sole attention, so as to obtain a clear idea upon the subject. Give me now that attention, and then I trust we shall not part without your knowing something about those Laws, and the manner in which they act. You recollect, upon the last occasion, I explained that all bodies attracted each other, and that this power we called *gravitation.* I told you that when we brought these two bodies (two equal sized ivory balls suspended by threads) near together they attracted each other, and that we might suppose that the whole power of this attraction was exerted between their respective centres of gravity; and, furthermore, you learned from me that if, instead of a small ball, I took a larger one, like *that* (changing one of the balls for a much larger one), there was much more of this attraction exerted; or, if I made this ball larger and larger, until, if it were possible, it became as large as the earth itself—or, I might take the earth itself, as the large ball—that *then* the attraction would become so powerful as to cause them to rush together in this manner (dropping the ivory ball), You sit *there* upright, and I stand upright *here*, because we keep our centres of gravity properly balanced with respect to the earth; and I need not tell you that on the other side of this world the people are standing and moving about with there feet towards our feet, in a reverse position as compared with us, and all by means of this power of gravitation to the centre of the earth.

I must not, however, leave the subject of gravitation, without telling you something about its laws and regularity; and first, as regards its power with respect to the distance that bodies are apart. If I take one of these balls and place it within an inch of the other, they attract each other with a certain power. If I hold it at a greater distance off, they attract with less power, and if I hold it at a greater distance still, their attraction is still less. Now this fact is of the greatest consequence; for, knowing this law, philosophers have discovered most wonderful things. You know that there is a planet, Uranus, revolving round the sun with us, but eighteen hundred millions of miles off; and because there is another planet as far off as three thousand millions of miles, this law of attraction, or gravitation, still holds good, and philosophers actually discovered this latter planet, Neptune, by reason of the effects of its attraction at this overwhelming distance. Now I want you to clearly understand what this law is. They say (and they are right) that two bodies attract each other *inversely as the square of the distance,*—a sad jumble of words until you understand them; but I think we shall soon comprhend what this law is, and what is the meaning of the " inverse square of the distance."

And now I will show you another experiment. Here is that piece of glass which before had no action upon the light. You shall see what it will do when we apply pressure to it. Here, then, we have our ray of polarised light, and I will first of all show you that the glass has no effect upon it in its ordinary state,—when I placed it in the course of the light, the screen still remains dark. Now Dr. Tyndall will press that bit of glass betyeen three little points, one point against two, so as to bring a strain upon the parts, and you will see what a curious effect that has. (Upon the screen two white dots gradually appeared). Ah! these points show the position of the strain—in these parts the force of cohesion is being exerted in a different degree to what it is in the other parts, and hence it allows the light to pass through How beautiful that is—how it makes the light to pass through some parts and leaves it dark in others, and all because we weaken the force of cohesion between particle and particle. Whether you have this mechanical power of straining, or whether we take other means, we get the same result, and, indeed, I will show you by another experiment that if we heat the glass in one part it will alter its internal structure, and produce a similar effect. Here is a piece of common glass, and if I insert this in the path of the polarised ray. I believe it will do nothing. There is the common glass (introducing it)—no light passes through—the screen remains quite dark; but I am going to warm this glass in the lamp, and you know yourselves that when you pour warm water upon glass you put a strain upon it sufficient to break it sometimes—something like there was in the case of Prince Rupert's drops. (The glass was warmed in the spirit lamp, and again placed across the ray of light.) Now you see how beautiful the light goes through those parts which are hot, making dark and light lines just as the crystal did, and all because of the alteration I have effected in its internal condition; for these dark and light parts are a proof of the presence of forces acting and dragging in different directions within the solid mass.

THE SIXTH ANNUAL NORMAN LOCKYER LECTURE will be given by Professor Sir William Pope, K.B.E., F.R.S. on Thursday, 13th November, 1930, at 4.30 p.m. in the Goldsmiths Hall, London, (by permission of the Goldsmiths' Company). The President of the British Science Guild, the Rt. Hon. Sir Samuel Hoare, Bart., G.B.E., C.M.G., LL.D., M.P., will take the Chair at the Lecture, the title of which will be announced later.

METHODS OF BORING AND WINNING TIN IN MALAYA.

By B. A. Hadley, B.E.

(*Read before Broken Hill Branch on 30th July*, 1929).

The author's object is to give a short account of the methods of boring alluvial tin properties in Malaya, and also to outline the methods of concentrating tin oxide by means of jigs.

Boring.

The tools required are of the Empire or Banka type, and the principal parts are as follows :—

A set of 5-ft. lengths of casting, 4 in. to 4½ in. diam., boiler tubing being commonly used; a number of 1 in. to 1¼ in. square iron rods of 10-ft. lengths and one or two similar 5-ft. lengths, all having tapered screw joints; four iron hand dogs or lifting tongs; several clack valve sand pumps; two clay auger drills; two chisel drills; one casting shoe; four iron clamps, which may be bolted on the outside of the casing, and which have handles 3 ft. long; one socket, which is screwed into the top of the casing to protect it from injury under working conditions; a wooden measuring box of which there are two types—

(1) A quarter cub. ft. capacity box, inside dimensions 6 in. x 6 in. sq. by 12 in. deep. The depth of the box is divided into tenths of a foot, denoted on the inside of the box by short nails driven into the wood.

(2) A half cub. ft. capacity box, inside dimensions 12 in. x 12 in. sq. by 6 in. deep, having a nail driven into the inside of the wood 3 in. from the bottom. This type of box is very much in favour.

Bore Sites.—In most cases the bore sites are set out by means of prismatic compass surveys and the position of each bore marked by a large peg. They are usually placed at the intersections of two series of lines from 3 to 12 chains apart, forming a number of rectangles.

Operation. The crew required consits of 8 coolies, 1 woman sample washer, and a tin dresser. Chinese are the most suitable for this type of work.

Initially a 10-ft. length of casing, having a protective shoe at the lower end, is embedded in the ground by means of heaving it up and down and twisting it around with the aid of the clamps, which are bolted across the centre of the casing. Four clamps are now bolted at right angles at the top of the casing, and a wooden platform placed upon them. The protecting socket is then

screwed into the top of the casing. Four coolies then mount the platform, and a 10-ft. length rod with a sand pump attached is lowered into the casing. Each coolie grips the rod with a hand dog, lifting, or rather throwing, up the rods and pump several feet, and, as they descend, they throw their weight on the hand dogs, thereby assisting the pump to enter the ground. Simultaneously the four remaining coolies turn the casing by gripping the ends of the four clamps, which are extended by means of short lengths of piping. Their object is to work the end of the casing down at such a rate that it should always be somewhat ahead of the drilling tool. Usually the weight of the four men on top of the platform is sufficient to ensure that the casing will descend easily, but, where very stiff clay or gravel is encountered, two thick pieces of iron rod are clamped across the drilling rods and the whole raised and allowed to fall on the top of the protecting socket of the casing.

When the sand pump will not enter the tough ground the clay auger is used to loosen it. The hole may then be cleaned out by means of the sand pump, which, when full, is pulled out of the hole and emptied into a shallow wooden tub.

A great deal of time is consumed in raising and lowering the tools, since each length of rod is unscrewed separately, and in a deep boring it is now becoming a common practice to increase the length of the sand pump from the 5-ft. lengths, formerly used, to 7 ft., enabling a considerable saving in time to be made. Rising sand is a frequent cause of difficulty, as it may flow up the casing until the bed of this material has been passed through. Since the accuracy of this method of boring is largely dependent upon the care with which the sample lengths are measured, caution should be exercised in interpreting the results from this large sample.

Unless changes in the nature of the ground are met with, it is usual to take samples at every 5 feet of depth.

The depth of the hole may be guaged by subtracting the length of rod projecting above the ground from the total length of the drill rods and sand pump.

The contents of the tub are placed in a measuring box of one of the types mentioned In the case of one of the first type of box being used, the whole is allowed to settle and the excess liquid poured off, and, whilst a certain amount of material is lost when the water is poured off from the sample, this loss is more than compensated for by the water which remains.

The quantity of material extracted may be read off in tenths of one quarter cub. ft.

Where the second type of box is used, it is first filled with water to the nail 3 in. from the bottom, the drained sample placed in the box and the amount of sample measured by the displacement of the water. This method gives much greater accuracy than the former in the case of stiff clays.

The pile-like effect of the casing forces a certain amount of material away from the mouth of the shoe, causing the actual quantity of the sample to be less than that necessary to theoretically fill the length of the casing.

The measured sample is then washed in a bucket until free from clay and other light finely-divided material and the sand and wash left is again measured, this measurement giving results which are of great use in determining the amount of clean water necessary for satisfactory treatment.

This sand and wash is then taken by the women sample washer and a rough concentrate is produced by a process similar to panning, which is carried out in a large wooden dish known as a "dulang." This concentrate contains all the tin as well as the associated minerals, and it is placed in a sample tin, carefully numbered and given to the tin dresser, who carries out the final washing. This concentrate is assumed to be pure tin oxide, and from the weight of this the value of each cubic yard of sample is calculated. A more accurate adjustment, however, may be made on the completion of boring operations for a property of the associated minerals usually discarded by the tin dresser are kept. Both this and the tin concentrate may be assayed for tin, and a correction applied for washing error. A good washer, even with small quantities of fine tin, should not lose more than 10 per cent.

Several special types of balances are in use for weighing the tin-dresser's concentrate, of which the most common is called the "datchang." This balance is graduated in what are known as "Valentine units," one unit representing, for a full bix sample, one cattie per cub. yd. (1 cattie = $1\frac{1}{3}$ lb.).

Many engineers prefer to use a balance which reads in ounces, and calculate the amount of tin per cub. yd. on the measured sample. In soft country it is comparatively easy to drill to depths of 110 ft., whilst much greater depths can be reached. It is not unusual for one gang to bore two 25-ft. holes in a day of about $7\frac{1}{2}$ hours.

Since the boring is always done on contract, it is advisable that one white engineer should not have to supervise more than two gangs.

Before the valuation of a property is complete a large number of check bores are put down by an entirely new gang under the supervision of a different engineer.

In very swampy country it is impossible to transport the plant expeditiously without the aid of " titi," that is, a series of posts joined by long poles along which the whole gang travels to and from the place of work. The titi is placed along the line of bore holes, and at the bore site a solid platform is errected, which serves as a stable base for the work.

Treatment.

It is only during the last four years that the use of jigs for treating alluvial material have come into prominence in Malaya. Although a dredge fitted with jigs requires considerably more power than one fitted with the old type of boxes, there is an increase in recovery, less labour is required, and the digging capacity for a given size of pontoon is increased.

The sizes of screens, classifiers, and the general arrangement of jigs mentioned below were found suitable for a number of dredges of a capacity of 120,000 cub. yd. per month, treating wash which contained tin oxide, practically the whole of which would pass through a 40-mesh screen.

The material from the buckets passes to a revolving inclined screen of 6ft. diam. and 34ft. long, which is perforated with ⅜in. holes. Jets of water play upon the material, assisting disintegration. The oversize is discharged through a chute to the stern, whilst the ⅜in. screenings pass to two classifiers, one on each side of the screen.

Two grades, coarse and fine, are obtained from the classifiers, and each grade is divided between two jigs; that is, there are four jigs receiving the product from each classifier. These are known as primary jigs. The spigot product from each jig is conveyed to a central sump, whilst the overflow is discharged by means of sand chutes to the stern of the dredge.

From the sump the spigot product is elevated by a 6in. gravel pump to a dewatering cone, which discharges directly to a distributing box placed centrally between the two secondary, or clean-up, jigs. The overflow from these jigs is also discharged to the stern of the dredge, whilst a concentrate may be collected from the spigot product of the first and, at times, the second compartment of each jig. The spigot product of the other compartments is returned by means of small hydraulic elevators to the sump of the primary jigs.

If the concentrate of the first compartment of each secondary jig is not sufficiently high grade, it may also be returned to the primary sump.

Classifier.—The classifiers are 6ft. wide and 20ft. long, and the bottom is a series of inverted pyramids of 2ft. base, being thirty in number and arranged in ten rows of three pyramide, each having a spigot at its apex. An overflow lip about 2ft. high is provided at one end, and the ⅜n. screenings enter the classifier by flowing over the opposite end. From this end also a current of water flows into the classifier from near the bottom, and carries the screenings along with it towards the overflow lip, depositing them in the pyramids, from whence they are discharged to the jigs.

The coarse product from the first row of three spigots is divided between two jigs, one on each side of the classifier, and the finer product, from the four following rows of spigots, is similarly divided between two other jigs. In the latter case, however, the number of spigots is excessive, and it is necessary to block off at least four of them and to reduce the orifices of the remainder, since the proportion of the water in the product would be too great. A wooden stop consisting of two 10in. × 2in. planks, one above the other, is placed across the classifier between the fifth and sixth rows of inverted pyramids. All the fine sand and water passing over the stop is discharged through the remaining five rows of inverted pyamids. Sufficient water, however, is flowing through the clossifier to ensure that a steady current passes over the overflow lip.

Primary Jigs.—The jigs are constructed of ¼in. steel plate, and are 16ft. long and 6ft. wide, having four compartments or hutches. Both the plunger and screen areas of these compartments are 3ft. × 4ft. The screens are of steel plate, having slots ½in. × ⅛in., and are supported on a cast-iron grid, another grid being placed upon the screen and the whole firmly held down by swanneck bolts attached to the upper framework of the jig. Both grids are tightly packed to the sides of the screen compartment by oakum hammered between the framework and the grid.

The four screens of each jig are set on a regular slope of 12in. in 16ft. Horizontally

bedded screens, which were stepped down between compartments, proved unsuitable. The number of strokes of the plunger is usually 80 per minute, and the length of the stroke of the coarse feed jigs is $\frac{3}{8}$in., and that of the finer feed jigs being $\frac{1}{2}$in.

Hæmatite ragging is most suitable, and is of various sizes up to $\frac{1}{2}$in. The depth of ragging on each screen is $2\frac{1}{2}$in., and it is held in position by wooden strips wedged across the screen compartment. New ragging being very angular shows a tendency to flow away with the tailings, but it soon becomes rounded and this tendency disappears The sides of the jigs are inclined toward the bottom and come together to form a V at a slope of 40° from the horizontal.

The tapered wooden spigot plugs, having a small pipe sunk in them, are very convenient, and may be easily pulled out to remove any obstruction in the spigot pipe, whilst on the cessation of dredging the flow of the spigot product is easily arrested by fitting a smaller plug into the pipe.

Secondary Jigs.—These are similar in construction to the primary jigs, but the regulation is different. The screens have a slope of 9in. in 16ft., and those of the first and second compartment have slots $\frac{1}{16}$in. × $1\frac{1}{2}$in., whilst those of the next two compartments have slots $\frac{1}{8}$in. × $\frac{1}{2}$in.

The number of strokes is 170 per minute, and the lengths of the strokes for the respective hutches are $\frac{1}{8}$in., $\frac{1}{16}$in., $\frac{3}{8}$in., and $\frac{1}{2}$in. Much finer ragging is used on the first two screens of each secondary jig, and crushed hæmatite of $\frac{1}{4}$in. and smaller is found suitable. The concentrate obtained may vary from 35 per cent. to 70 per cent. tin oxide. As a very large proportion of "amang" or associated mineral, is returned again and again to the primary sump, it is advantageous to relieve the system from time to time by taking off a poorer concentrate.

When digging very rich material a sufficiently high-grade concentrate may be obtained from the spigot of the second hutch of each jig.

The concentrate is placed in iron or wooden buckets and conveyed to the tin shed, where it is washed until a very high-grade product is obtained.

General Considerations.—In keeping a check on the performance of the system, the tails of each jig are sampled regularly every hour. The tailings at the stern of the dredge may also be carefully bored. With correct regulation, the tail samples of all the jigs should show practically no tin oxide, whilst the borings of the tailings rarely reveal a greater loss than .08 lb. tin oxide per cub. yard. This loss is considered due to the imperfect action of the revolving screen. Careful regulation of the water flowing over the jigs is very necessary. A heavy current of water will carry away appreciable quantities of tin, as the particles may not have an opportunity to reach the sand and ragging upon the screen. Great care must be taken to ensure a clean supply of water to the classifier and jig compartments, and, as the water in the lower depths of a dredge paddock may contain more than 25 per cent. solids, it is customary to get rid of this by means of a slum pipe which runs off this extremely dirty fluid from the bottom of the dredge paddock. When dirty water is used the ragging sets stiffly, hence reducing the effective screening surface as well as carrying away considerable quantities of tin oxide.

It is a good practice to periodically take out the ragging and clean the slots of the screens of the small pieces of hæmatite and other material which may clog them. This also has the advantage of freeing the bed and ensuring that it will be fully active.

The capacity of a jig may be stated as approximately 22 yds. per hour, but this quantity would, of course, vary with the nature of the wash.

Tin Dressing.

The concentrates are washed in coffin-shaped boxes, known as "lanchutes." They are 12ft. long and have a slope of 1 in 12. Across the upper end is a wooden stop, which may be 6in. high. A small quantity of concentrate is placed in the lanchute just below this stop. A stream of water is allowed to flow over the concentrate, and, as it runs down the slop towards the outlet end, it is continually raked back by a coolie, using a long-handled "changkol," which is similar to a long-bladed hoe set at an angle of 45° to the handle. A second coolie at the outlet end drags back the concentrate, which flows away from the top by means of a flat board. This last product is shovelled out and set aside for retreatment, the material escaping from the lower end of the lanchute being later collected and may be washed again.

The concentrate remaining at the top of the lanchute is finally placed in a fine sieve, which is moved up and down in a suitable vessel of water, a rotatory motion being given at the same time, and in this manner the impurities are collected at the centre on top of the tin concentrate, and removed by hand.

Willoughby boxes are frequently used on coarse poor-grade concentrate as a preliminary to final washing.

The final concentrate ranges from 70 per cent. to 76 per cent. tin, and a second grade of concentrate of from 55 per cent. to 65 per cent. tin is obtained from the tin-shed residues.

These products are dried and placed into bags, each bag containing approximately 90 catties (1 cattie is equivalent to $1\frac{1}{3}$ lb.). It is the local custom to sell the ore once a fortnight, and it is practically always sold to one of the local smelting companies, since there is a heavy export duty on unsmelted ore.

LABOUR.

The population of Malaya is most heterogeneous, and a great variety of labour is obtainable. The Chinese, however, are the most satisfactory for nearly every purpose from coolie labour to office clerk. Bengalis who have had some experience on Indian ships are frequently available as engine drivers, and are very satisfactory.

Tamilis from southern India, locally known as Klings, are used to some extent for coolie abour, but as a general rule their physique and intelligence are not of a very high standard. They also have the unfortunate habit of chewing betel nut, and experience much delight in expectorating on any conspicuous object.

Malays are polite and intelligent, but prefer not to work if it can be avoided; however, they are useful as survey coolies since the work entails the cutting of lines through dense jungle, at which they are very expert.

Sikhs make excellent police and watchmen ,having dignity and splendid physique. Higher caste Indians are also available as clerks, and are neat and accurate.

It is customary to employ several nationalities of labour on each mine since there is less liability of a united action against the management in the case of any dispute.

Malay is the universal language, and the bazaar Malay as spoken amongst the coolies is very simple, and a working knowledge can easily be obtained in a few months.

It is the author's opinion that the use of English-speaking natives, except for office positions, should be avoided, since they are often very self-opinionated, cunning, and extremely loquacious; in fact, a general nuisance.

LIVING CONDITIONS.

Living conditions on most mines are fairly pleasant, comfortable bungalows being supplied by the management, and, where the properties are close to the railways, supplies of cold storage meat and ice may be obtained daily.

Dredging being a continuous operation, it is customary for the staff to work 7 days a week, though liberal leave may be obtained.

The cost of living, including a cook and boy, should not be more than £3 to £3 10s. per week.

Malaria is not prevalent as is commonly believed, and those who contract it are regarded as unfortunate. It is more likely to be contracted in the jungle and in newly opened-up areas than in the established mining districts.

POTASH SALTS IN THE MARITIME PROVINCES OF CANADA.

(L. H. COLE, *Department of Mines.*)

Although commercial deposits of potash salts have not yet been found in Canada, there are a number of localities in which indications have been encountered so promising as to be well worthy of detailed study. Prospecting of such localities is, however, a costly matter, as it usualy involves core drilling by special methods in order to recover all the soluble salts in the strata drilled.

The world's requirements of potash in 1927 were valued at $100,000,000, of these Germany and Alsace produced 95 per cent. Canada in the same year imported 22,721 tons of various grades of potash salts valued at $1,234,355. Details of such imports for 1926-28 are given in the accompanying tables.

Potash salts are employed principally for fertilizing purposes. Canada does not at present use fertilizers on so extensive a scale as some of the European countries, but the time is not far distant when the demand for artificial fertilizers, including those containing potash, will greatly increase. If, therefor a commercially workable deposit of potash salts can be proved to exist in Canada it would prove of great benefit to the whole country. In fact such a development would be of even wider interest because no extensive deposits of potash have been exploited within the British Empire.

There are a number of localities in eastern Canada where mineral springs, drill holes, or mining operations have shown the presence of potash salts in varying quantities. Several localities in the Maritime Provinces where these salts have been noted will be briefly described.

BASE EXCHANGE WATER SOFTENING.

An Interesting New Publication.

By A Well Known Engineer.

The importance of zero hardness water and the Base Exchange method of water softening for many different industries, and especially as regards saving of soap, does not of course require much emphasis. In this connection there has just been published by the Paterson Engineering Co., Ltd., of London, an interesting booklet "Soft Water for the Laundry," dealing with the latest developments of the firm's Base Exchange plant, and the general use of their material "Basex."

This is a high grade artificial sodium aluminium silicate, contained as usual, supported on a gravel bed, within a steel cylinder through which the hard water is allowed to flow, the raw water being introduced at the top of the shell and distributed *uniformly through the material, while the* pure zero hardness water is taken from the bottom. Also there is fitted the usual arrangement of a brine tank for reviving, along with the necessary pipes and valves, and one particular point claimed is the rapidity of the regeneration, which is less than 20 minutes after an 8-hour run.

It will be remembered that the main chemical reactions of a Base Exchange plant are the interaction between the soluble calcium and magnesium salts, constituting the temporary and permanent hardness, and the Base Exchange material, the sodium in the latter being replaced by the calcium and magnesium, while the sodium sulphate and the sodium bi-carbonate, equivalent to the permanent and temporary hardness respectively, pass into the zero hardness water, which therefore is alkaline in the case of raw water containing temporary hardness. This, however, constitutes no objection in many applications, such as textiles, rather the reverse, and when the Base Exchange material is exhausted, then a solution of salt is poured through, whereby the sodium is replaced and the material rendered active again, the calcium and magnesium running to waste in the spent brine as calcium and magnesium chloride.

The saving of soap is very great, even when compared with 5° hardness water such as given by the lime and soda ash process when carried out on the most scientific lines, and apart from this there is no question that the presence of calcium and magnesium salts in the solution tends to "dull" or "grey" the shades of fine fabrics. Also of course small amounts of lime soaps are formed which have highly objectionable properties, and undoubtedly for most branches of textile work the ideal is absolutely zero hardness water.

Another good point claimed for "Basex" is its great resistance to solution and disintegration by CO_2, while in a very large establishment there is much to be said for combining a Base Exchange and lime and soda ash plant in series on the "dual" principle, thus obtaining the advantages of both systems.

A DELICATE REAGENT FOR COBALT.

By E. A. Lum.

The following test for cobalt may be of some interest to students. If a solution of cobalt nitrate be shaken with acetone or ether-amyl alcohol mixture *after dilution*, and then 15.-20 per cent. ammonium thiocyanate added and shaken, a blue-green layer or solution indicates cobalt. It is important to use a strong thiocyanate solution as a dilute (1 per cent.) solution was on trial found to be useless. This test has been shown to detect 1-500 of cobalt in a solution. Nickel, if present, sometimes gives a red aqueous layer, the cobalt colouration remaining in the acetone layer. This, however, is found to vary, an nickel should be confirmed by the dimethylglyoxime test, or by adding a 1 per cent. solution of the sodium salt of a-benzildoxime, when a pink precipitate indicates nickel. The following separation of Group IV. (III. B) metals has been repeatedly tried and found satisfactory. Dissolve the sulphide precipitate after washing well, in strong nitric acid in a fume cupboard, and whilst boiling sprinkle in $KClO_3$ *very carefully*. Any black precipitate indicates *Mn*. Cool, dilute, and filter the solution and divide into three portions: (1) Neutralise with NH_4OH, add a trace of acetic acid and then dimethylglyoxime—salmon-pink precipitate indicates *Ni*. (II) Add strong $NH_4C:N:S$ solution; shake with ether-amyl alcohol mixture—blue-green layer or solution indicates *Co*. (III.) Add excess NaOH solution, filter and pass H_2S — white precipitate indicates *Zn*. Students will find the above separation *much more satisfactory* than some of the dry borax-bead tests, which are often applied for nickel and cobalt.—*The Pharmaceutical Journal and Pharmacist.*

GENERAL NOTES

WORLD'S LARGEST MUNICIPAL ABATTOIR.

LIVERPOOL CONTRACT FOR BRITISH FIRM.

The Liverpool Corporation has just placed the contract for the equipment of their great new abattoir at Stanley with Messrs. J. & F. Howard, Ltd., of Bedford, one of the associated firms of Agricultural and General Engineers, Ltd.

The contract will mean the employment of several hundred men for a full year.

The Liverpool abattoir, which will be the biggest municipal undertaking of its kind in the world, has been designed in accordance with the most modern practice for humane killing and hygienic handling of meat. It will have capacity for dealing with no less than 1,000 cattle, 900 calves, 7,500 sheep and pigs—11,400 animals a day. It is being built and equipped to the designs of Mr. T. Laurie Price, the well-known London consulting engineer, in consultation with Mr. Albert D. Jenkins, F.S.I., land steward and surveyor to the Liverpool Corporation.

The fact that the plant will not only be the biggest municipal plant but also the most efficient and up-to-date in the world and all-British is a welcome reminder of the supremacy which the British engineering industry has obtained over foreign competitors in a line of work until recently was entirely in the hands of U.S.A.

Other contracts of a similar nature which have been secured during the last three year by Messs.Howard against U.S. competition include the equipment of the new works for Bovril Ltd., in the Argentine, the reconditjoining of the Smithfield & Aargentine Meat Company's plant in the Argentine, the the equipment of -the Argentine Co-operative Farmer's works at Entre Rios and of five sheep abattoirs in Iceland.

CANADIAN ANHYDRITE AND ITS POSSIBLE USES.

Anhydrite, the anhydrous calcium sulphate, has been considered for many years to be of little commercial value, and when encountered in the mining of gypsum has usually been considered as an impurity and discarded. Recently, however, attempts to find commercial uses for anhydrite have produced such encouraging results that the mineral promises to become an article of considerable industrial importance. The successful development of further uses for anhydrite is of great importance to Canada as large deposits of the mineral are found associated with gypsum in Nova Scotia, New Brunswick, Ontario, Manitoba, Alberta and British Columbia, and at many of the gypsum quarries in these provinces large quantities of anhydrite have already accumulated.

At present approximately 5,000 tons of anhydrite are shipped from Nova Scotia each year to the southern areas of the United States which border on the Atlantic seaboard, where it is ground and used as fertiliser for the peanut crops.

In England and continental Europe considerable tonnages of anhydrite are used in the making of ammonium sulphate for fertiliser purposes. Recent investigations in the United States and elsewhere have demonstrated that it is possible to use as much as 50 per cent. anhydrite with gypsum as a retarder for Portland cement.

However, the greatest interest has recently centered in the use of anhydrite for the manufacture of commercial plasters, and patents have been filed in Canada, the United States and Europe in which anhydrite forms the base for such plasters. The pioneer work in this line in Canada has been carried on by Professor A. E. Flynn, Professor of Mining Engineering at the Nova Scotia Technical College, Halifax, N.S., and his report entitled "Anhydrite Plasters and Cements" published by the Department of Public Works and Mines, Halifax, Nova Scotia, shows that plaster's made from anhydrite with the addition of varying small proportions of certain chemical salts as catalysers would "set" and in a number of cases produce a tensile strength comparable to many gypsum plasters now on the market.

The Mines Branch, Department of Mines, Ottawa, is now engaged in an investigation of the anhydrite deposits of Canada with a view to determing the extent of the deposits and the chemical and physical characteristics of the rock from different localities, and laboratory tests are under way at Ottawa carrying on the work started by Professor Flynn at Halifax.

IRISH FREE STATE TRADE.

A marked improvement in Irish Free State Trade is indicated in the official returns for the first six months of this year. The adverse trade balance on June 30 was £10,872,643, compared with £14,146,360 at the end of June last year.

WATER POWER IN CANADA.

According to the Royal Bank of Canada circular the power projects of Canada now under development in Canada will necessitate the expenditure of more than one hundred million dollars a year during each of the next three years. Investment on this scale constitutes objective evidence of a substantial belief in the continued expansion of Canadian industries. This estimate of the future capital requirements of the electric power industry is from a recent publication of the Dominion Water Power and Hydrometric Bureau of the Department of the Interior, and is based upon conservative estimates of the probable cost of the projects already undertaken. Expenditures of this type have a far reaching influence upon business.

The present turbine installation averages 583 horse power per thousand of population, a figure which places Canada among the leading countries of the world in per capita utilization of water power. The total installation now amounts to over 5,700,000 horse power and an additional installation of over 3,000,000 h.p. will probably be made within the next five years. Quebec has the largest installation with an average of nearly one horse power per person.

OVERSEAS TRADE.

The Secretary to the Overseas Trade Development Council announces that the personnel of the Economic Mission to South Africa is as follows:—

The Right Hon. Lord Kirkley (Chairman)
(Ex-President of the Chamber of Shipping of the United Kingdom; Chairman, Cairn Line of Steamships, Ltd.

Sir Francis l'Estrange Joseph, C.B.E., J.P.
(Chairman and Managing Director of Settle Speakman & Co., Ltd., Mosefield Colliery, Ltd., and Bignall Hill Colliery Co., Ltd., President of the North Staffordshire Chamber of Commerce since 1923).

Mr. John Morgan.
(Agriculturist: Member of East Sussex branch of the Farmer's Union: Member of the Agricultural Advisory Committee to the Labour Party; has made a special study of agricultural marketing problems).

Mr. Robert Waddington.
(Cotton Spinner and Manufacturer: Ex-Member of Parliament for Rossendale Division of Lancashire; associated with prominent local authorities).

Mr. J. W. Brigden.
His Majesty's Trade Commissioner at Johannesburg, who will act as Secretary to the Mission).

It is intended that the Mission shall leave for South Africa on the 8 August next and shall visit Southern and Northern Rhodesia as well as the Union of South Africa.

MARKET FOR DISINFECTANTS, INSECTICIDES AND ANIMAL DRESSINGS IN THE REPUBLIC OF HONDURAS.

A confidential report on the market for disinfectants, insecticides and animal dressings in the Republic of Honduras has been prepared by the Department of Overseas Trade from information furnished by His Majesty's Chargé d' Affaires at Tegucigalpa and issued to firms whose names are entered on its special register.

Firms desirous of receiving a copy of this report together with particulars of the Special Register service of information and form of application for registration should communicate with the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. Reference B.X.6688 should be quoted.

MARKET FOR DISINFECTANTS, INSECTICIDES AND ANIMAL DRESSINGS IN BOLIVIA.

A confidential report on the market for disinfectants, insecticides and animal dressings in Bolivia has been prepared by the Department of Overseas Trade from information furnished by His Majesty's Vice Consul at La Paz, and issued to firms whose names are entered on its Special Register.

Firms desirous of receiving a copy of this report together with particulars of the Special Register service of information and form of application for registration should communicate with the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. Reference number B.X.6673 should be quoted.

THE SECOND ANNUAL ALEXANDER PEDLER LECTURE will be given by Lt.-Col. Sir David Prain, C.I.E., F.R.S., on Wednesday, 22nd October, 1930, at 5.30 p.m. "Science Discipline" is the general subject of this Lecture, which will take place in Liverpool under joint auspices of the University of Liverpool and the British Science Guild.

SAFETY IN MINES RESEARCH BOARD'S ANNUAL REPORT.

The Eighth Annual Report of the Safety in Mines Research Board, that for the year 1929, has just been published. The Report is mainly devoted to brief accounts of the progress of the numerous researches which are being carried out either directly under the Board or by Committees of the Board, or at Universities and other centres with the aid of funds supplied by the Board.

The subjects include problems relating to coal dust explosions, firedamp explosions, spontaneous combustion of coal (including the treatment of gob-fires), the safe use of electricity in coal mines, mining explosives, safety lamps, falls of ground, wire ropes, the control of mine temperatures and mine ventilation, and mine rescue apparatus.

The Report also embodies an account of the progress of the health enquiries carried out under the supervision of the Health Advisory Committee, principally in regard to dust inhalation and the problems of silicosis and allied questions.

The Report is obtainable, either directly or through any bookseller, from H.M. Stationary Office, Adastral House, Kingsway, W.C.2., price 1s. net.

PHOTOGRAHPY SIMPLIFIED — AND TONING.

A booklet under the title of "Photography Simplified—Printing and Toning " has just been issued and treats in the fullest and most helpful manner the problems associated with making the best possible prints and in obtaining realistic effects by using stains and toners.

Important information is confirmed pictorally where practicable. One illustration shows how necessary it is to choose the right paper, another how to find the correct exposure without waste of time and material, and a third discloses an ingenious yet simple accurate method of finding the density of a negative. The artistic and realistic effects obtainable by the judicous use of 'Soloid' Stains and 'Tabloid' Toners are amply demonstrated.

The booklet will be sent post free to any reader of the *Chemical News* by the Publishers, Burroughts Wellcome & Co. Snow Hill Buildings, E.C.1.

GENERAL INDEX TO THE "CHEMICAL NEWS"—VOLS. 1 TO 100.

This large Volume contains a detailed *Index to the first 100 Volumes of the Chemical News*, and will be found of great value to all interested in Chemical Engineering, Electrical and General Scientific subjects. It has been compiled with great care, is handsomely bound in red cloth, and has been produced at great expenditure of time, labour and money. Carriage paid, Great Britain, 21/- net; Carriage paid to Foreign Countries and the Colonies, 23/- net.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

23,436.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of acetylene. Aug. 5.

23,697.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of polycyclic compounds. Aug. 7.

23,853.—Lainau, A., and Vorlander, D.—Preparation of ammonium sulphate and nitrogen. Aug. 8.

Specifications Published.

332,911.—I. G. Farbenindustrie Akt.-Ges. —Manufacture and production of derivatives of quinoline.

310,815.—I. G. Farbenindustrie Akt.-Ges. —Process for the manufacture of 2-chloro-benzo-thiazoles.

332,983.—Imperial Chemical Industries, Ltd., and Leicester, F. D.—Concentration of aqueous acetic or formic acid.

814,899.—I. G. Farbenindustrie Akt.-Ges. —Process for the manufacture of condensation products of the anthraquinone-acridone series.

Printed copies of the full published specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2., at the uniform price of 1/- each.

Abstract Published.

330,904.—Sulphonated hydroxy fatty acids, etc.—I. G. Farbenindustrie Akt.-Ges., Frankfort-on-Main, Germany.

Sulphonated products are obtained by treating higher unsaturated hydroxyfatty acids such as ricinoleic acid, or their esters such as castor oil, with gaseous sulphur trioxide while stirring and cooling. The reaction is preferably carried out in the presence of an organic diluent or solvent such as carbon tetrachloride, perchlorethane, hexachlorethane, or trichlorethylene, and the sulphur trioxide may be introduced by passing it over the solution in a current of a dry inert gas, for example, air or nitrogen. The acids or esters may, if desired, be first reacted upon with sufficient sulphuric acid monohydrate or chlorsulphonic acid to esterify the hydroxy groups, and the products then further treated with gaseous sulphur trioxide as described above. Examples are given. The provisional Specification refers to the use of unsaturated hydroxyfatty acids and their derivatives in general as starting materials, and mentions benzene as a suitable organic diluent. Specification 296,999 is referred to.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official *Trade Marks Journal, and is Published* by permission of the Controller of His Majesty's Stationery Office.

CURO.

511,481.—Chemical substances for use as sizing materials in the textile industry.—H. Th. Bohme Aktiengesellschaft, 29, Moritzstrasse, Chemnitz, Saxony, Germany. August 13th.

EPLOK.

514,431.—Chemical substances for use in repairing leaky radiators and similar water containers.—Leah Fitelson, 32, Murray Street, Higher Broughton, Manchester. Aug. 13.

LAKOSINE.

512,041.—Chemical substances used in manufactures, photography, or philosophical research, and anti-corrosives.—B. Winstone & Sons, Ltd., 100, Shoe Lane, London, E.C.4. Aug. 13. (By consent).

GRAMMAR OF LOGIC.

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BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

ANNUAL MEETING AT BRISTOL, SEPTEMBER 3-10, 1930.

THE PRESIDENTIAL ADDRESS. SIZE AND FORM IN PLANTS.

By PROFESSOR F. O. BOWER, Sc.D., D.Sc., LL.D., F.R.S.,

PRESIDENT OF THE ASSOCIATION.

Two years have passed since the Association last met in Britain. Events have happened in that interval which mark the close of the Darwinian Epoch. Down House, in which Darwin lived and worked, has been bought, restored and endowed by Mr. Buckston Browne and presented by him to the Association, who hold it in custody for the Nation. The house is now open as a shrine to those who treasure Darwin's memory. They may enter the study where the 'Origin of Species' was penned, or wander out to the Sand Walk, and draw such inspiration as those spots may yet afford to those who are face to face with problems cognate to his own. These years have also severed personal links with Darwin himself. Sir William Thiselton-Dyer, who died in December 1928, had been his frequent correspondent. It was he who, more than any other, carried the evolutionary stimulus forward into the botanicle schools of Britain. Sir Edwin Ray Lankester, whose portrait by Orpen was a poignant feature of last year's Academy, died in August 1929. Not only was he the leading Zoologist of his time, but he has left a deep impress on general Morphology; for he was the first to analyse from the evolutionary aspect the degrees of 'sameness' of parts, whether in animals of in plants. These two octogenarians were among the latest links between Darwin himself and living men in science. And so this last meeting of the Association before its centenary next year falls at a nodal point in the personal history of Evolution.

Morphology, or the study of Form, was closely interwoven with the life's work of Darwin, and—to use his own words—'It is one of the most interesting departments of natural history, and may almost be said to be its very soul.' Since the Association has seen fit to choose as this year's President a botanist whose work has dealt specially with form in plants, the occasion seems apt for considering certain morphological questions that present themselves in this eight decade since the 'Origin of Species' was published.

The word 'Morphology' was applied by Goethe in 1817, in a general sense, to the study of form. Though a pre-Darwinian, he showed rare foresight in insisting that the living form is only momentarily stable, never permanent. But years elapsed before that instability of form of living things, which he clearly saw, become the very focus of evolutionary theory. Even Goethe's prophetic gaze was blurred by the hazy imaginings of Idealistic Philosophy. The clarifying mind of Schleiden resolved that mist by resort to naked fact. In 1845 he stoutly asserted that the history of development is the true foundation for all insight into living form. This opened the way for a host of workers, who patiently observed and compared the facts of individual development, particularly in plants of low organisation. By them the field was prepared for the magic touch of Darwin; and, in the enthusiastic words of Sachs, 'the theory of descent had only to accept what genetic morphology had actually brought to view.'

The effect of that theory should have been to sweep aside all Idealistic Morphology based on the higher forms, and to rivet attention upon organisms low in the scale. It was the habit of starting comparison from the highest state of organisation that was the fundamental error of the idealistic nature-philosophers; even now traces of it still persist. An illuminating alternative was presented by that noble passage with which the 'Origin of Species' ends. Speaking of his theory, Darwin wrote: 'There is a gradeur in this view of life, with its several powers, having been originally breathed by the Creator into a few forms, or into one; and that—from so simple a beginning endless forms most beautiful and most wonderful have been, and are being evolved.' He forecasts from the application of his theory that 'our classifications will come to be, as far as they can be so made, genealogies; and they will then truly give what may be called the plan of creation.'

Whether there was only one original form of life or many is still an open question. Nevertheless, among the welter of organisms rightly held as primitive, the Flagellata may with some degree of reason be named as combining in their motile and sedentary stages respectively the animal and vegetable characters. They suggest a sort of starting point from which the two kingdoms might have diverged. The probability of their common origin is strong; but the divergence must have been early, each taking its own independent course, with increasing

size and complexity of the individual. In tracing this I would ask your special attention this evening to the Kingdom of Plants.

The first of the laws laid down by Lamarck[1] in his *Histoire Naturelle* as fundamental in the evolution of animals and plant ran thus: 'Life by its intrinsic forces tends *to increase the volume of every living body*, and to enlarge its parts up to a limit which it determines itself.' When in unicellular organisms, following this law a certain size has been reached, fission follows, and the equal halves separate as new individuals. In pluricellular bodies, however, the products of cell-division do not separate, but continue a communal life; and the individual may increase, with further division of its cells, to large size and complexity. We may picture how, based upon the mobile stage of a Flagellate, the aggregate might form an animal body with motility as a leading feature; on the other hand, based upon the sedentary stage, an immobile plant-body would result. The animal, adopting a predatory habit and colourless, might progress along lines of dependent nutrition, finding and ingesting food already organised; the sedentary green plant might evolve along lines of physiological independence, constructing its own organic supplies. Whether or not this be a true picture, the whole organisation of the two kingdoms diverged on the basis of nutrition. Herbert Spences contrasted them physiologically, showing how animals are expenders, while plants are accumulators; that the former are limited in their grawth by the balance of expenditure against nutrition; in the latter growth is not so limited. Thus the problems that follow on increasing size may be expected to work out differently in view of the animal kingdom comprising organisms of high expenditure and not self-nourishing, while plants are self-nourishing accumulators.

The result of this indifference may be illustrated by contrasting some of the highest examples of either kingdom; for instance, the elephant with the trees of the forest through which he roams. On the one hand, the relative fewness of the mobile elephants, their less stature and compact form, their columnar legs needed to support the barrel-like body, the receptacle for ingested food, the economy of external surface and the highly developed internal surface. On the other hand, the height, immobility and large number of trees, with their massive stems and highly complex shoots and roots, so necessary for requiring food directly from the air and soil. We may further contrast the genesis of the individual in either case. In the mammal the parts are formed once for all, its embryology may be continued for centnries, and is theoretically unlimited, except by death;; during life it has the power of producing leaves and branches from every distal bud. The fact is that, though certain underlying principles are the same for both kingdoms, the working out has been distinct from the first. Hence the morphology of plants must stand on its own feet; indeed it has been said with some degree of truth that whenever botanists have borrowed their morphological outlook from the sister science they have gone wrong.

The normal development of a multicellular plant starts from the fertilised egg, and elaboration both external and internal follows on ncreasing in size. Polarity, that is the distinction of apex and base, is defined in most plants of high organisation by the first cell-cleavage. The apex adops at once the continued development that is its characteristic. Branching of various types follows in all but the simplest, to constitute the complex shoot, while correlative basal braching gives the root-system that fixes the non-motile body in the soil. The scheme of growth and branching thus started is theoretically open to unlimited increase, and the initiation of new parts is in point of number on a geometrical scale. This is suitable enough for organisms able to accumulate material, as plants do; indeed, the elaboration of the vegetative system will enhance its powers of self nutrition, so far as the parts become functional; but this is never fully realised beyond the earlier steps.

The focus of all such development is the growing point, respectively of root or shoot. Anyone who carefully dissects a suitable bud peeling off the successively smaller leaves, may finally see with the naked eye or with a simple lens a pearly cone of semi-transparent tissue at the tip of the stem. This is the growing point itself, which possesses theoretically unlimited formal power. It is like a permanent sector of the original embryo that is fed continually from the mature tissues below, and as continually forms fresh tissues at the tip. But as the tip advances, lateral swelling of the surface appear in due order, which are new leaves and buds. Various attempts have been made to link the

[1] Lamark died in 1829, and the Association has contributed to a fund being raised for a Memorial by the Linnæn Society of Northern France.

genesis of these outgrowths of the radial shoot with the outer world as regards their position and number. But we have it as the *latest authoritative statement on this point* that such a relation does not exist. 'This much is proved,' says Prof. von Goebel, *that*, '*so far as we can see, the question re*lates to conditions of growth and symmetry that arise in the growing point.' 'All theories as to leaf-position that allotted a passive role to the growing point were mistaken, however acute the reasoning that was brought to bear thereon' (*Organographie.* 3rd Edn., part 1, pp. 299-300). This is Von Goebel's summing up for external parts On the other hand, within the growing point, and often, though not always, related to the external parts, there is a progressive formation of internal conducting tracts, continuou from the adult region upwards to the tip. A like reference of the origin and disposition of these vascular tracts to the growing point itself appears to be equally justified. In fact the tip possesses the initiative for both.

The complex shoot that results from such initiation is exposed as it matures to external conditions which modify its form. Their effect is very obvious in the young shoot of the higher plants. As the shoot elongates its young tissues are soft and plastic. While in this state its form may be influenced by gravity, the incidence of light, mechanical contact and other causes which produce reactions of form called 'tropisms.' All of these promote the well-being of the whole. The net result becomes fixed as the part matures, and its constituent tissues harden. Thus the adult form is the consequence of the primary initiation at the growing point, modified by the conditions to which the plant may have been exposed during the plastic period. This is a commonplace of the text-books. But amid all the careful analysis and experiment that has been devoted to the influences which thus affect form, one factor, insistent and unavoidable, has been habitually left out, viz., the influence of size Reference is occasionally made in text-books to the effect of surface-tension in determining the simple form in minute organisms, such as unicellular Algæ and Bacteria, and to the deviations from that simple form as the size increases, and the influence of surface-tension ceases to be dominant. At the other end of the scale of size mathematicians have calculated the extreme stature mechanically possible for a tree-trunk constructed after the ordinary plan, and of materials of known strength. The result is about 300 feet, and this coincides approximately with the limit of height of the canopy of a tropical forest. But in point of size practically the whole of the vegetable kingdom lies between the microbe and the forest tree. Unfortunately the study of these middle terms, from the point of view of change of form as the size increases, has not been pursued by botanists with the same preception as zoologists have shown in the stndy of animals.

At the back of all problems raised by increasing size stands the well-known principle of similarity, which applies to all structures inorganic as well as organic. It involves among other consequences that where form remains unaltered bulk increases as the cube hut surface only as the square of the linear dimensions. But in living organisms it is through the limiting surfaces, or 'presentation-surfaces,' as they are called, that physiological interchange is effected. Provided a surface be continuous and its character uniform, it may be assumed that such interchange will be proportional to the area of surface involved. If, then, the form of the growing organism or tissue were retained as at first—for instance, a simple sphere, oval or cylinder—its surface to transit would increase at a lower ratio than the bulk which they enclose. There would be with increase in size a constantly decreasing proportion of surface to bulk, and as constantly an approach to a point of physiological inefficiency. But any change from a simpler to a more complex form would tend to uphold the proportion of presentation-surface. Thus the success of a growing organism might be promoted by elaboration of form. Naturally other factors than that of size co-operate in determining form. Nevertheless the recognition of such elaborations of form, whether external or internal, as do tend in point of fact to maintain a due proportion of surface to bulk as growth proceeds, should help to make morphology a rational study. The diffuse form habitual for plants, even the origin of leaves themselves, becomes intelligible from this point of view.

In the constrution of any ordinary vascular plant there are three of these 'presentation-surfaces' or limiting surfaces of transit, that are of prime importance: (i) the outer contour by which it faces the surrounding medium; (ii) the sheath of endodermis which envelops the primary conducting tracts; and (iii) that collective surface by which the dead woody elements face upon the living cells that embed them, through which water and solutes pass in or out.

Each of these may vary independently of the others, and each would be a fitting subject for observation as bearing on this problem of size. But as a test case of the relation between size and form, it is the collective surface where dead wood faces on living cells that will meet our requirements best, for its study can be pursued among fossils almost as well as in living plants. The problem is one not merely of current physiology of the higher plants, it is one of adaptive progress. Accordingly measurements must be made of the wood fossils as well as of living plants, and of young sporelings as well as of the adult.

We have seen that plants are essentially accumulators of material. A natural consequence of this is that primitive types, endowed with apaical growth but no secondary cambium, will enlarge from the base upwards. Any sporeling fern shows this. The leaves themselves increase in number; each successive leaf is as a rule larger than the one that came before, and the stem that bears them also expands upwards. In fact it takes the form of an inverted cone. To grasp the size-problem for primitive plants the mind must be rid of the idea of the forest tree, with its stem tapering upwards, for that is a state of highly advanced organisation. The primitive form of stem is that of an inverted cone, enlarging upwards with a solid core of wood within. A cone standing upon its tip is obviously unpractical Not only is it mechanically unstable, but if the original structure be maintained so that the larger region above is structurally a mere magnified image of the smaller below, a constantly diminishing proportion of presentation-area to bulk must needs follow, in respect of all the limiting surfaces. Such stems would all tend to become physiologically insufficient. Our immediate problem is with the woody column. How can that due proportion of presentation-surface of the dead wood to the living cells, which physiologists hold to be essential, be maintained in the expanding stem, so as to meet the increasing requirements of transit and distribution of the sap

(To be concluded.)

BRITISH IRON AND STEEL.

Furnaces in blast decreased during July from 133 to 105 and pig-iron production fell a further 77,100 tons. The output of crude steel, on the other hand, was 21,300 tons larger than in June.

THE SPEED OF FLAME IN A CLOSED TUBE.

By Yûzaburô Nagai.

The author studied the speed of the flame in mixtures of air with the vapour of hydrocarbon. The flame was made to propagate in a horizontal glass tube of 26 mm. in internal diameter and 110 cm. long, both ends of which were closed. The gaseous mixtures were fired at a point near one end by means of the electric spark. The speeds of the flame were determined by the photographic method.

The hydrocarbon used in this study was the same as one in the previous research. It was a mixture of about 43 per cent. of dimethyl cyclopentane and about 57 per cent. of isoheptane.

The following table shows the mean speeds of the flame over a run of 100 cm. after travelling 5 cm. from the spark-gap.

Mol. percent. of hydrocarbon in gaseous mixtures	Speed of the flame (m./sec.)
1.50	0.83
1.90	3.8
2.00	5.1
2.02	5.3
2.06	5.8
2.08	14
2.19	14
2,25	15
2.50	14
2.70	8.5
2.80	8.3
2.90	5.6
3.10	2.1

The flame-speed in a closed tube is largely affected by the expansion of burnt gas and by its rapid cooling which takes place shortly after the start of ignition. From this it results that the flame speed in a closed tube is very much higher than that in an open tube, and that the speed in a closed tube is largely affected by a small change in the concentration of the combustible, as can be seen at the concentration of about 2.08 per cent. of the hydrocarbon in the above table.

The concentration of the hydrocarbon in the maximum speed mixture is about 2.25 per cent., which is larger than that for the complete combustion (1.92 per cent.), but smaller than that for the maximum speed in an open tube. This fact is to be ascribed to the dissociation of carbon dioxide at high temperatures, and to the decrease in the degree of dissociation when the pressure is [illegible] r the pressure produced

in a closed tube is far higher than that in an open tube.

The author derived theoretically that, if there is no current at all in the gaseous mixture, or if the mixture moves only in a direction parallel to the axis of the tube, the flame propagating in the mixture should take the shape of a disc, which is perpendicular to the axis of the tube. But the snapshot photographs of the flame taken by the author show frequently very irregular forms of the flame. This is considered to be caused by the turbulance of the gas at the flame.—*Department of Applied Chemistry, Faculty of Engineering, Tokyo Imperial University.*

SHRINKAGE IN UNITED STATES COAL OUTPUT.

Although a seasonal reduction of coal output is normally expected in June, the production in June, 1930, besides being well below that for the same month of each of the four previous years, was also the lowest reported since July, 1927. The reduction was due to the diminished bituminous output. The aggregate coal output (34,730,000 tons) included 30,102,000 tons of bituminous, and 4,628,000 tons of anthracite coal. The bituminous production averaged 1,204,000 tons per working day in June, as compared with 1,216,000 tons in May, and 1,378,000 tons in June, 1929. The corresponding daily averages for the anthracite output were 185,000 tons, 204,000 tons, and 181,000 tons respectively. A further shrinkage in the rate of pig iron production was shown for June. The aggregate output, and the average daily make in June, were, respectively, the lowest since February and January last, when production was the smallest for two years. The tonnage of pig iron produced per calendar day averaged 97,800 tons, as against 104,280 tons in May, and 123,910 tons in June, 1929. Furnaces in blast at the end of June numbered 160, as compared with 180 at the beginning of the month, twenty furnaces having been blown out or banked during June, and none blown in. Steel ingot production was also diminished in June. The total and daily outputs were the lowest recorded for the present year, and, with the exception of those for November and December, 1929, were the lowest since December, 1927. On the basis of 25 working days reported for June, the daily make averaged 137,610 tons, as compared with 140,070 tons in May and 196,150 tons in June, 1929.

THE ISOTOPES OF NITROGEN, MASS 15, AND OXYGEN, MASS 18 AND 17, AND THEIR ABUNDANCES.

By S. Meiring Naude.

Ryerson Physical Laboratory, University of Chicago.

I. The Isotopes of Nitrogen and Oxygen.—The absorption spectrum of the NOγ bands, in particular that of the (0, 0) band at λ2269, the (1, 0) band at λ2154 and of the (2, 0) band at λ2052 was studied in search of isotopes of nitrogen and in order to verify the recently discovered isotopes of oxygen of mass 18 and 17.

A hydrogen continuous source was constructed which could be operated by means of a 5 K.W. transformer which gave 0.5-0.75 amps. through the secondary. It was shown that the silvering of the capillary tube joining the electrodes acts as a catalysing agent which accelerates the recombination of the hydrogen atoms to molecules thus increasing the intensity of the continuous spectrum. Owing to a chemical change in the fused quartz window on the hydrogen source which leaves the quartz coloured to a violet tint if light of shorter wave-length than λ1850 falls on it, the intensity of the continuous spectrum below λ2300 is reduced considerably. This was overcome by using a crystal quartz window which did not show this effect. The photographic plates were sensitised with vaseline.

A glass tube 92 cm. long and 5 cm. in diameter with quartz windows sealed on to either end was used as an absorption tube. NO was prepared by dropping a solution of $NaNO_2$ into $FeSO_4$ and H_2SO_4.

Band heads were observed in all three bands investigated corresponding to the calculated heads for the four kinds of molecules $N^{14}O^{16}$, $N^{15}O^{16}$, $N^{14}O^{18}$, and $N^{14}O^{17}$, the maximum deviation of the observed wave-lengths from the calculated values being 0.035A. The results obtained therefore provide new evidence for the existence of a nitrogen isotope of mass 15 and verifies the existence of the oxygen isotopes of mass 18 and 17.

II. The Relative Abundance of O^{16} and O^{18}.—From the atmospheric bands of oxygen Babcock obtained the relative abundance of O^{16} and O^{18} to be 1250 with a probable error of 25 per cent. $(O^{16})_2$ is symmetric whereas $O^{16}O^{18}$ is not. This may give different absorption coefficients for the two molecules. This difficulty disappears

in NO. By comparing the pressures of NO in the absorption tube at which the (1, 0) P_1 $N^{14}O^{16}$ head could be made to have the same intensity as the P_1 $N^{14}O^{18}$ head the relative abundance of O^{16} and O^{18} was found to be 1075 ± 110.

The Relative Abundance of N^{14} and N^{15}.—Because in the (1, 0) band the P_1 $N^{15}O^{16}$ head has the same intensity as the head Q_1 $N^{14}O^{18}$ head, the relative abundance of the N^{15} and O^{18} isotopes is inversely proportional to the relative intensity of the P_1 and $Q_1 N^{14}O^{16}$ heads. This relative intensity was found to be 0.65 ± 0.1. The relative abundance of N^{14} and N^{15} is therefore 1075×0.65 or 700 ± 140.

From the relative abundance of O^{16} and O^{18}, and O^{16} and O^{17} the mass of the O^{16} isotope was calculated to be 15.9980 ± 0.0002 if the atomic weight of the mixture of isotopes was taken to be 16.0000. Aston defines the mass of the O^{16} isotope as 16.000 and consequently his atomic weights are higher than the corresponding chemical atomic weights. The chemical atomic weights and Aston's should agree if we correct the O^{16} isotope to an atomic weight of 15.9980 ± 0.0002, that is by 1.25 parts in 10000.

The mass of the N^{14} isotope was calculated to be 14.0069 ± 0.0012 which is in close agreement with Aston's corrected value of 14.0063 ± 0.0029.—*Physical Review.*

RUBBER IN COAL.

Miners in the German lignite (soft coal) deposits frequently come across patches of a fibrous substance that they name monkey's hair.

Botanists have analysed the substance and made a close examination of the layers in which is occurs. In the latter they discovered large quantities of fossil leaves, which were nearly all of one well-marked type, and they ascertained that it was the ribs of such leaves that had been preserved, and which constituted the "monkey's hair."

Chemical analysis revealed the presence in these leaves of shreds of indiarubber, and this, with the fact that the leaves had the form of those of the indiarubber plants that are used to-day as a household decoration, convinces the scientists that indiarubber trees flourished in prehistoric times in the districts where the great central German lignite deposits now exist. It is highly progable that those trees were of the type that now grows so plentifully in the tropics of Asia.

SEVENTY YEARS AGO.
(From the Chemical News, Jan. 7, 1860.)

SORGHO DYE.

W Winter, of Austria, has discovered a carmine-colouring matter in most parts of the Chinese sorgho, especially in the expressed stem, and has obtained a patent in Austria, Baden, and other states. The process is as follows :—The sorgho is pressed in the usual manner, and the empty cane piled up under cover in regular heaps, several feet high, and the fermentation which immediately sets in so directed by more or less access of air as to prevent it from becoming putrid. After two weeks the whole mass is of a reddish-brown or red colour, when the fermentation is interrupted by drying. When dry the mass is graund sufficiently fine for the extractraction of the colouring matted. It is covered in the proper vessels with cold soft water, and allowed to stand for 12 hours; but little of the pigment dissolves during that time. It is then drained, and afterwards treated with a weak caustic soda, or potash ley until this no longer extracts anything. This solution is carefully neutralised with sulphuric acid, thus precipitating the colouring matter in red flakes, which after settling, is washed in water, collected on filters, and dried. This colour dissolves in alcohol, alkaline leys, dilute acids, &c. and is employed for the dyeing of silks and woollens with the common tin mordants.

ANOTHER GYPSUM INDUSTRY FOR NEW BRUNSWICK.

The Canadian Gypsum Company, Ltd., a subsidiary of the United States Gypsum Company of Chicago, Ill., is about to erect at Hillsborough, 18 miles southeast of Moncton, N.B., a mill for the manufacture of Gypsum products. The new factory will be the first of a chain of modern gypsum plants which the Company proposes to established in Canada, the programme adopte involving the investment of several millions of dollars in the construction of gypsum and lime plants which will produce a large variety of patented products used in building construction. The new plant at Hillsborough is on tidewater near the mouth of the Petitcodiac River where the Company's four ocean-going vessels can load the finished products for export.

CZECHOSLOVAKIA'S CHEMICAL TRADE.

A report presented at the recent annual general meeting of the Union of Chemical Manufacturers in Czechoslovakia says that following the steady upward economic trend throughout 1927 and 1928, the year 1929 produced in Czecholovakia, as in most other European countries, a retrograde movement which was particularly emphasized from July onwards. As the chemical industry proper provides raw materials for most other branches, the general economic trend was reflected in the development of chemical sales. These showed a decided downward tendency in the second half of the year. Some branches of industry, such as the glass cellulose, iron and metalworking branches proved able to make good to some extent in increased exports the ground they lost in the home market, and in these cases purchases of chemicals were fairly well maintained though even here they were below the level of preceding years. On the other hand there was a decided regression in chemical purchases for the textile and leather trades. In order to counteract these circumstances to some extent at least, chemical manufacturers had to take up the output of various species of chemicals hitherto imported. The conditions in respect of artificial fertilisers were particularly unsatisfactory.

The chemical industry in Czechoslovakia comprises altogether some 670 establishments and gives employment to upwards of 45,000 workers. About 80 per cent. of the total output is exported. The value of the exports inclusive of by-products is over 200 million crowns per annum, while imports amount to over 400 millions.

The industry dates from as early as the XVII century, and in the second half of the XVIII century sulphuric acid manufactured in Bohemia was exported to many parts of the world. Since the establishment of an independent Czechoslovakia in 1918, considerable progress has been made in developing this industry. Its main centres are at Usti (Aussig) on the Elbe and elsewhere in the north-west of Bohemia and at Kolin, at Ostrava in Morvaia and in Slovakia.

Conspicious is the development of fixed nitrogen, produced by a direct ammonia synthesis since early in 1928 by the Czechoslovak Nitrogen Works in Moravská Ostrava, and by the synthetic plant at Aussig. Although the plant at present produces only 30 tons of ammonium daily of an expected 60 tons, part of which makes ammonium sulphate, this concern proposes to develop certain nitrate salts, starting with calcium nitrate for fertilisation of the local beet, potato, and grain crops. Nitrogen is fixed also at a cyanamide plant at Falknov, producing at the rate of about 30,000 tons of the finished product annually. It also contemplates a lignite-distillation and tar-cracking process.

Along with its fertiliser nitrogen, the Czechoslovak Nitrogen Works are supplying the Czechoslovak Explosives Works (industrial and military explosives monopoly) with ammonia, while the latter, with its associated " Synthesia " plants at Semtín near Pardubice, is further developing production of nitric acid and nitrates for technical use.

Czechoslovak production of other mineral acids, notably sulphuric, is on the increase. Capacity for the sulphuric-acid production was increased last year, and the ten local superphosphate enterprises can now meet home requirements for this important fertiliser, even if Czechoslovakia still imports some superphosphate by international agreement.

Without fertiliser potash from domestic sources, this country has however, a sizable industry making potassium carbonate from wastes in the sugar and spirits industries.

Acetic acid production is self-sufficient, with export capacities, along with the other products of destructive wood distillation, originating in ancient plants located on the hard-wood forest reserves of Ruthenia. This branch, however has lost former export markets in view of synthetic development abroad.

Production of coal tar shows a progressive increase, having attained 130,000 metric tons in 1929. This material is processed by the firm of Julius Ruetgers of Moravská Ostrava, connected with the Ruetgers Co., of Berlin, Germany.

Another source of rather unique wealth for the pharmaceutical (and colours) branch primarily is the occurrence of pitch blends or uranium ore at Jáchymov in northwest Bohemia. The ore is partly reduced to radium chloride, the latter being used by at least two pharmactutical producers to make so-called radioactive therapeutic preparations.

Important Radium Find.

Prof. Stoklasa, the well-known Prague expert, who was called in to give his opinion on the recent discovery of traces of radium at Ostrov (Schlackenwerth) in northwest

Bohemia, forecasts a big future for the springs and soil there. The quality of the soil, he says, is something quite new in the history of radium. Water in which it is placed becomes at once radoactive, and the mud makes an ideal baths medium of great efficacy. The soil has also great importance as a fertiliser. Ostrov is about five miles south of Jáchymov (Joachimstal) where Madame Curie first discovered radium, and about eight miles from Carlsbad.

THE HISTORY OF ORE TREATMENT PROCESSES IN BROKEN HILL.*

E. T. HENDERSON.

*From the Proceedings of the Australasian Institute of Mining Metallurgy.

When mining and treatment first started at Broken Hill only oxidised ores were available. These ores were rich in silver and lead —the silver mainly existing as chloride and the lead as caronabte. Treatment processes aimed mainly at the recovery of silver, lead being regarded as a by-product, and its recovery, except in so far as it affected silver recovery, was of minor importance.

The first ore mined was carted to Terowie and thence railed to Melbourne, being smelted by the Intercolonial Smelting and Refining Co,. of spotswood.

The first parcel (50 tons) returned £7442, or £148 16s. per ton to the Broken Hill Proprietary Company.

The second parcel of 1053 tons, smelted at the Day Dream smelter, returned 132,142 oz. of silver, but no record is available as to its lead content.

These results obtained from two parcels showed that by smelting the ore a handsome profit could be obtained, and Mr. La Monte was engaged to erect two 30 ton Nevada water jacket blast furnaces on Block 13. These furnaces were placed in charge of Mr. P. Conway, and the opening ceremony was performed by Mrs. Brodribb on the 6th May, 1886.

Smelting in Broken Hill in those days was by no means a simple operation. Both the ores and the fluxes varied considerably in composition, and it is not to be wondered at that the slags produced then were high in lead and silver. The coke supply was nearly always short of requirements, and at times it was difficult to keep the furnaces alight until another load of coke arrived.

These first two furnaces were quickly followed by three more, making five in all, with a total capacity of 500 tons per week.

About Easter, 1887, Mr. H. H. Schlapp arrived, and took charge of the smelters. He brought with him greater experience, and an immediate improvement in furnace practice resulted.

About October, 1887, the foundation of a smelter was laid down on Block 14, and new smelters were erected under Mr. Schlapp's supervision on the British and also on Blocks 12 and 13. By October, 1888, there were eight furnaces in full blast on Block 13. Later, furnaces were also erected on the Central and South mines.

The furnaces on the Broken Hill Proprietary mine were rapidly increased in number and size, until 15 furnaces of 80 tons capacity were in full lbast and treating 4500 tons per week .

The bullion from these furnaces were shipped to Europe for refining until December, 1889, when the Broken Hill Proprietary Co,. erected a refinery at Port Pirie. This plant was designed by Mr. Schlapp, and thenceforward the bullion was sent there for refining.

About this time the British and Blook 14 compauies shifted their smelter to the seaboard. The former chose Port Pirie and the latter Port Adelaide. The Junction company later also erected a smelting works at Port Adelaide.

On the Proprietary mine the necessity for some form of concentration prior to smelting soon became evident. This first took the form of hand picking . In this way a lot of very low grade ore, high in silica, was removed with advantage in smelting oeprations. As the tonnage required by the smelters increased, the need of some mechanical appliance tp accomplish this orwk was felt, and a concentrating mill was designed and erected on American lines. This was completed in July, 1889, and was the first ore-dressing plant on the Barrier. It was known as Holleys mill, and had a capacity up to 300 tons daily. The ore was crushed by steam stamps (Ball type) and then treated on 16 primary Collom jigs, eight fine jigs, five revolving tables or buddles of the 3-Deck type. Frue banners were also used. This was a great improvement on hand picking, but the lead and silver loss in the tailing was high. Of course, only oxidised ore was being treated at this time, and the silver, largely present as choride and being light in gravity, tended to pass out with the tails.

An experiment was made in this mill to see if the sulphides could be concentrated

into a product suitable for the smelters. It aws found, however, that the zinc content of the lead concentrates could not be kept low enough to suit the emelting operation. Mr. C. G. Hylton, who was employed in the erection and running of this mill, has, therefor, the honour of being activily associated with the first mill erected here, as well as with several other later ones.

In June, 1890, a leaching plant was erected to recover the silver which was lost in the tails from the concentrating plant, and also to treat the highly siliceous ores which were unsuitable for direct smelting.

This plant consisted of 12 leaching vats, 12 precipitating vats, and four storage vats. It treated 2800 tons a week. The ores were leached with hyposulphite of soda solution which dissolved the silver. This solution was then run to the precipitating vats, where sodium sulphide solution was added, the silver precipitated as sulphide and the solution regenerated.

In 1894 the concentrating plant had to be removed, as mining operations had caused the ground on which the plant was built to subside.

Before this date a concentrating plant had been erected on the British plant was bought by the Proprietary and re-ereeted with its own mill on the new site, which was between Dickenson's shaft and the present ore dressing mill. The new mill was known as Pearson's mill. In this mill, which was really an experimental one, dry crushing in fast running rolls was tried, and various types of jigs were experimented with, among which may be mentioned the Pearson jig (a modified Hancock), the Humbolt, the Harz, and the May.

The May proved to be the best jig, and was adopted in the next mill erected. Dry crushing rolls were supeseded by slow running cornish rolls.

In 1896 the Proprietary Co., bought the smelters which had been erected by the British company at Port Pirie. The Proprietary then gradually transferred all their smelting operations there. These smelters, together with the refining plant previously mentioned, formed the nucleus of the present smelting and refining plant at that port.

As the carbonate stopes became more and more depleted, attention aws turned to the treatment of the suphide ores. This presented a very difficult problem in those days. Several leading metalurgists were consulted in the matter, chief among whom was Dr. Schnabel, a leading German metalurgist. Several methods were suggested and tried, but the first stage in solving the problem was made by modifying the gravity concentration pant, so as to recover the major portions of the lead contained in the ore as a high grde galena. As the silver in the sulphides was intimatey associated with the galena, its recovery closely followed that of the galena.

The chief alterations consisted in the substitution of jaw breakers and rols for the steam stamps previously used, and also the installation of May jigs. Belt vanners were instaled for the treatment of the finer portions of the crushed ore.

With the treatment of the sulphide ore, lead became of major consequence, in point of actual value and as a necessary accompaniment to high silver recovery.

The zinc sulpbide contained in the ore was dumped, partly with the tailing and partly with the slimed portion of the ore, which was produced by crushing and which, owing to its fineness, was not amenable to gravity concentration. This slime was run into dams and settled.

A new ore dressing mill to treat 5000 tons of snlphide ore a week on the above lines was erected on the Proprietary mine put into operation in October, 1897. In this mill Wilfley tables and tube mills were also included at a later date.

Other mills were also erected along the line of lode, but their starting dates are not available. The loss of metals in these mills was very high, only about 60% of the lead and 50% of the silver being recovered in a marketabe form. The loss in slime production amouited to 15% to 20% of the ore crushed, and assayed higher in lead and silver than the crude ore.

The tailing or zinc middling, as this product is now known, accounted for the rest. These zinc middling dumps and slime dams grew rapidly, especially when the Broken Hill Proprietary Co. reached an output of from 13,000 to 14,000 tons a week. They covered the flat between the mine and the town. Accumulations also formed at the sites of the other mills.

The zinc contents of the dumps naturally attracted the attention of the various managers, and several attempts were made to recover the blende as a high grade zinc concentrate. When a crude ore rich in zinc, was treated, a middling containing between 30% and 40% zinc was often produced from the jigs. This was high enough to be shipped to Europe, and several thousand

tons of it were sent there. This, however, was only a small proportion of the production, the rest being far to low in grade to dispose of in the same way.

Various attempts were made to concentrate this low-grade material to shipping grade by gravity methods, but with little success, the specific gravity of the associated minerals being too close to that of blende.

About the year 1900 magnetic separation was tried and proved more encouraging. A plant was erected by the Australian Metal Company on land near brick kiin in West Broken Hill, and another plant was erected on the Central mine.

These produced a good grade of concentrate, but had a very small tonnage capacity Being a dry process, the dust produced by the middling passing over the machines caused a lot of worry at the outset. Improvements were made which, to some extent, overcame this trouble, but under the best conditions dust was bad.

Wet magnetic separation was also tried, but did not give as good resutls as the dry process. Experiments, too numerous to mention, were made to try and recover the zinc as a saleable product by chemical means, but all of them were commercial failures.

This brings us to the discovery, or to be more correct the rediscovery, of the flotation process, developments of which are so largely used in Broken Hill and numerous other parts of the world today.

The old saying that " there is nothing new under the sun " certainly seems to be true in the case of flotation.

Flotation depends on the affinity of the surface of certain minerals for air, or oi, or both, in preference to water. This is often referred to as their aversion to become wetted.

The earliest record of this was discoverd in some ancient writings, which showed that the Romans recovered gold from sands by means of feathers dipped in oil. The gold stuck to the feathers and the sand was washed away .

The idea of entrapping minerals in oil, together with a method of carrying it out, was patented by Carrie J. Eveson in the United States of America in 1885. Her claim read : " In the separation of pulverulent ores containing rocky gangue the method of treatment herein described which consists in mixing with such pulverulent ore a fat or an oil, or constituent thereof, an acid, or soluble neutral, or acid salt, and water, finally breaking up the mass to allow the sands to separate therefrom."

This breaking up was done by means of water, and the sands were washed out, leaving the valuable minerals entangled in the oil or fat.

GENERAL NOTES

ELECTRICITY IN THE IRISH FREE STATE.

The activities of the Electricity Supply Board during the past three months have not been as spectacular as during previous quarters, but they have been none the less vigorous, says the *Irish Trade Journal.*

The Merchandising Department of the Board has been concentrating on developing the domestic side of the electrification scheme. With that end in view a Home Service Section was established some months ago and specially qualified instructresses, all trained in domestic science from the electrical standpoint, were engaged.

The Industrial Power Department, which has been operating since last autumn is now in full swing and is busily engaged in making arrangements for a supply of power to various industries where a supply of Shannon current is available. Alread electric power from the Shannon is being used in the following industries :— corn milling, creameries, dead meat factories, bakeries, ice-making, salt-making, engineering works, laundries, printing works, saw milling, furniture-making, stone-cutting, marble polishing, ink-making, boot and shoe factories, building works, shipbuilding, mineral water factories, ice cream manufacture, oil refineries, and it is being extensively adopted for water and sewage pumping, and for driving lifts.

The Industrial Power Department is also engaged in preparing for demonstrations throughout the country of electrically-driven hand tools, such as electric drills, electric grinders, electric hammers, electric soldering irons, electric wood workers, electric stone cutters, electric saws, electric polishers, buffing tools, etc. A preliminary exhibition and a working demonstration of these electric tools were given at the Technical Teachers' Congress, held in Cork in June last, and considerable interest was manifested in them.

A Lighting Service Department has recently been established, and a Lighting Service Bureau will be opened in Dublin to assist in the planning of proper lighting for factories, shops, and the home, and to demonstrate how the best effects can be achieved.

THE BRITISH NON-FERROUS METALS ASSOCIATION.

The British Non-Ferrous Metals Research Association has secured a leasehold factory property, Regnart Buildings, Euston Street, London, N.W.1., where it is proposed to centralise its offices and provide accommodation for a laboratory and workshops for its research and technical development departments.

The Association, founded ten years ago, has made steady progress under the direction of Dr. R. S. Hutton, and now carries out work for all sections of the non-ferrous metal industry on a scale of expenditure of £20,000 to £25,000 per annum.

A special appeal for increased annual support and contributions to a Headquarters' Fund has recently been launched and has met with partial success, despite the present difficult industrial conditions.

The Association has already demonstrated its value to industry, particularly in the discovery of new engineering materials and in solving problems of increasing the efficiency of production and of overcoming the causes of defects, matters of great economic importance which should warrant increased membership and support from the metal and engineering trades.

The British Non-Ferrous Metals Research Association has just enlarged its staff by appointing Mr. D. H. Ingall, D.Sc., as Assistant Director and Research Manager, to take effect from January next. Dr. Ingall is well known for his metallurgical research and administrative work, and as first Principal of the Constantine Technical College, Middlesboro, has been largely responsible for its equipment and organisation.

Dr. O. F. Hudson will continue as Senior Metallurgist of the Association.

Mr. G. L. Bailey, M.Sc., of the Metallurgy Section, Research Department, Woolwich, has been appointed from September 1 as Development Officer to fill the position recently vacated by Mr. S. J. Nightingale, who resigned to occupy an important position in industry.

EINSTEIN REPROACHES THOUGHTLESS ENTHUSIASTS.

At the opening of a wireless exhibition in Berlin recently Professor Einstein said there are millions, who thoughtlessly use the wonders of science and technology, without having grasped them intellectually, any more than a cow understands the botany of plants it chews.

SPEED TRIUMPH OF NEW METHODS OF CONSTRUCTION.

In an age when we are for ever being bidden to look to America for prodigies of speed and efficiency in architectural achievement, it is satisfactory to be able to point to a British architect and British contractors who between them are beating all previous records for rapid building.

Thames House, Westminster, which is growing up beside the House of Lords on the left bank of the river is, in the words of a writer in *The Times Trade and Engineering Supplement*: "probably the most remarkable example in the world of rapidity of construction in modern building. For without any sacrifice of good workmanship these offices are being completed at a rate that even surpasses the boasted rapidity of erecting skyscrapers in the United States."

Some account of the difficulties encountered and of the manner in which they were overcome will serve to indicate what is in these days remembered less often than it should be, that British workmanship and British organisation have still nothing to fear from comparisin with those of any other country in the world.

Thames House is a study in rationalised construction, and an object lesson to architects and contractors. The magnitude of the task can be appreciated by a glance at the following statistical table :—

Total frontage	1,652 feet.
Number of windows ...	2,000
Glass area	67,000 feet sup.
Length of cable for 4,500 electric light points ...	66 miles
Length of piping in heating panels	80 miles
Area of hollow tile floors	770,000 sq. ft.
Length of corridors ...	Over 3 miles
Number of glazed tiles	620,000

The primary disadvantages were many. The tidal reactions of the Thames, the potentially easy flooding of the foundations, their necessary depth, the high cost of the site, the enormous expense of erecting a building with a total cubic content of nearly 12,000,000 feet and a total fabric weight of 200,000 tons—these were factors that seemed likely to increase the cost of overcharges to an unprecedented degree. A careful supervision of every detail, however, and the use of devices not generally employed kept costs down.

Thus concurrently with the erection of 12,000 tons of steel framework, the pipes and conduits for such services as the cen-

tral vacuum cleaning installation were fixed. Provision for the lighting points, which will consist of a square fitting of frosted glass set into a metal frame flush with the ceiling, was made during the actual construction of floors and ceilings, to avoid expensive breakages and interference later.

To facilitate the hoisting of building materials and the translation of workmen from one part of the building to another both exterior and interior lifts were installed along with a huge outside staircase over a hundred feet high. A telephone exchange was installed as another time-saving factor.

At an early date in the erection of the "steel cage" several of the reinforced concrete floors were built in, thus providing substantial centres for building operations which otherwise might have been delayed. As a result, it will be possible to complete some parts of the building by June, 1931, and allow occupation to tenants who, by their rents will still further contribute to the reduction of the huge initial costs. The whole building will be completed by October, 1931.

UNITED STATES BUSINESS CONDITIONS.

For the time being new commitments continue to be avoided and business is reduced largely to current demands, working off stocks, and reducing expenses. Foreign trade figures for the first half of the year show reduced exports in every month except March and smaller imports.

NICKEL IN MINING MACHINERY.

The connection of Cornwall with the mining industry dates back to many centuries before the Christian era. The early records are obscure, but we know that the Phœnicians carried on an active trade with the Cornish people, exchanging the products of the Mediterranean countries for the tin won from the mines on the seaboard.

Since those early times, Cornwall has maintained its contact with mining, although the industry has suffered severely during recurrent periods of depression, when low prices for metal have made working unprofitable. Probably Cornish mining reached its zenith in the early years of the nineteenth century, during which period, it has been stated mining areas extended in an unbroken chain from Lands End to the Tamar.

The industrial age was then just beginning and the times were ripe for mechanical development. Watt's steam engine was an established success and others were assiduously working to develop the new source of power. To Cornwall belongs the honour of producing the world's first successful locomotive, which was run over the roads of Camborne by that distinguished engineer, Richard Trevithick, in 1801. The same year saw an extension of Cornwall's contact with the mining industry through the activities of Nichoas Holman, who built the boilers for the inventor's high-pressure engines. Holman began a small enterprise for supplying the needs of the local mines and it was in this modest way that the great Camborne firm of mining machinery manufacturers which bears his name had its genesis.

During the latter half of the nineteenth century mining expanded at a very rapid rate all over the world, and there was an insistent demand for men with mining experience to develop the new fields. Cornwall contributed its full quota. Between the years 1851 and 1891, over 170,000 miners emigrated from this country, and the opening up of the great mining fields of South Africa, Australia, America, Canada and the Far East was largely the work of men born and trained in Cornwall. The new fields created new markets and the firm of Holman Bros. Ltd., rapidly attained worldwide repute as a producer of the highest class of mining machinery.

The company were probably best known in the early days for their rock drills, many hundreds of which are to be found in the world's largest and most famous mines. Within recent years the range of their activities has widened, and a great variety of pneumatic tools and appliances, used in practically every industry, are now manufactured at Camborne. One of the most interesting of the company's recent productions is a "silenced" road ripper, in which the exhaust noise is eliminated without loss of ripping speed. This ripper eliminates the necessity for the nerve-racking noise of present day road-breaking and demolition operations. It is to be hoped that contractors will display sufficient public spirit to adopt the new type of ripper, particularly for work conducted in the vicinity of hospitals, where noise is very much out of place.

Three of the most recent products—rock drills, Hele-Shaw Beacham air compressors and Superhauls—are of interest to mining engineers, prospectors and the executives of large properties.

FOREIGN.

In his report to the Shareholders of Allied Cement Co., Ltd., at their Annual Meeting on July 31st. the Chairman, Mr. Oliver J. S. Piper, referred to the increase competition from foreign cement, pointing out that while foreign cement is cheaper to purchase than British cement, the British buyer is no longer able to save the difference, since he must, apart from the question of quality, pay in addition a sum to the British workmen for not making it, in the shape of the purchaser's contribution to the cost of unemployment itself. If these facts were better appreciated by Municipalities and Contractors who are buying foreign goods because they appear to be cheaper, it would be of advantage to the Cement Industry of this country.

SALT PRODUCTION IN CANADA.

The production of salt in Canada in 1929 was estimated at 330,264 tons valued at $1,578,086, an increase of 10.3 per cent. in quantity and of 5.5 per cent. in vaue over the 1928 total of 299,445 tons worth $1,495,971.

Deliveries in 1929, exclusive of the salt content of brine used in the manufacture of chemicals, averaged $8.70 per ton as compared with $8.28 per ton in the previous year.

An increase of 8 per cent. was recorded in Ontario's production, the total for 1929 being 302,445 tons or 91.6 per cent. of the Canadian production. The output from the Malagash mine in Nova Scotia continues to advance, and the 1929 production was 42 per cent. higher than the total in the previous year.

Canadian imports of salt decreased 6.6 per cent. to 176,566 tons with a value of $936,820. Salt exports from Canada totalled 9,359 tons value at $70,762, as compared with 2,930 tons worth $36,399 exported last year.

Capital employed in the salt industry by the 8 firms operating in 1929 totalled $4,576543. Employment has furnished 53 salaried employees and 371 wage-earners; there combined earnings were $516,453. The cost of fuel and electricity used during the year was $249,664: this total included $226,552 paid for 51,808 tons of bituminous coal.

IODIDE AND ANIMAL GROWTH.

The African Chemist and Druggist says that quite some interest is being shewn in S. Africa in iodine and its salts, owing to the reseaches that are being made in the well-known Mellon Institute and the Philadelphia College of Pharmacy. In regard to these researches, undertaken by the Chili nitrate producers of iodine, it may be useful to point out that previous researches have proved that potassium iodine is of considerable value in promoting the growth and health of domestic animals generally.

Both the United States and the British Governments have conducted experiments in their respective agricultural experimental stations for the purpose of ascertaining information concerning the action of potassium iodide when administered to pigs, cows and poultry. The results obtained indicate that when very small amounts of this familiar iodine is administered in the food, the animals take on flesh more rapidly and are healthier in all respects.

It was found that the best results were obtained when the iodide was mixed with a large proportion of calcium carbonate.

ENGLISH AGRICULTURE.

It is stated that there are 30,672,000 acres of agricultural land in England and Wales, without reckoning anything less than one acre in a holding. The value of this land, with the buildings on it, is quite £800 000.000, compared with £74,000,000 invested in cotton. In addition, we have fully £300,000,000 working capital employed in agriculture."

PUBLICATIONS RECEIVED.

UNITED STATES DEPARTMENT OF THE INTERIOR—GEOLOGICAL SURVEY.

Revision of the Lower Eocene Wilcox of the Southeastern States. By Edward Wilber Berry. Professional Paper 156. Price 75 cents.

Surface Water Supply of Hawaii. July 1 to June 30, 1925. By N. C. Grover, Chief Hydraulic Engineer. Water Supply Paper 615. Price 20 cents.

Geology and Water Resources of the District Hawaii. By Harold T. Stearns and William O. Clark, with a chapter on Ground Water in the Hawaiian Islands. By Oscar E. Meiner. Water Supply Paper 616. Price 85 cents.

The Green River and its Utilisation. By Ralf R. Woolley. Water Supply Paper 618. Price $1.25.

Surface Water Supply of the United States, 1926. Part I. North Atlantic Slope Drainage Basins. By N. C. Grover, Chief Hydraulic Engineer. Water Supply Paper 621. Price 30 cents.

Surface Water Supply of the United States, 1926. Part IX. Colorado River Basin. By N. C. Grover. Chief Hydraulic Engineer. Water Supply Paper 629. Price 20 cents.

Surface Water Supply of the United States, 1926. Part XII. North Pacific Slope Drainage Basins. A. Pacific Slope Basins in Washington and Upper Columbia River Basin. By N. C. Grover, Chief Hydraulic Engineer. Water Supply Paper 632. Price 20 cents.

The Chakachamna-Stony Region, Alaska. By Stephen R. Capps. Bulletin 813-B. Price 10 cents.

U.S. Department of Commerce.
Bureau of Standards.

Plain and Thread Plug and Ring Gage Blanks. Miscellaneous Publication, No 100. Price 15 cents.

Blistering Phenomena in the Enamelling of Cast Iron. By A. I. Krynitsky, W. N. Harrison. Research Paper No. 179. Price 30 cents.

On a Modified Method for Decomposing Aluminous Silicates for Chemical Analysis. By A. N. Finn and J. F. Flekotka. Research Paper No. 180. Price 5 cents.

Union of South Africa. Department of Agriculture.

An Economic Investigation of Farms in the Maize Districts of the Orange Free State. By J. C. Neethling, B.A. (S.A.), Ph.D. (Cornell). Bulletin No. 81. Price 3d.

Forthcoming Events.

THE INDIAN SCIENCE CONGRESS, 1931.

The Eighteenth Annual Meeting of the Indian Science Congress will be held at Nagpur from the 2nd to the 8th January, 1931. Dr. U. N. Brahmachari, M.A., M.D., F.A.S.B., has been appointed President of the Section of Medical and Vetinary Research.

In view of the fact that a very large number of papers have been received in past years it is impossible to read all of them in the time available, and necessitating the curtailment of discussion on others, the Sectional Committees have been advised to make a careful selection of papers accepted.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

24,024.—(I. G. Farbenindustrie Akt.-Ges.). —Manufacture of esters of the leuco compounds of vat dyestuffs. Aug. 11.

24,406.—(I. G. Farbenindustrie Akt.-Ges.). —Manufacture of arsonic acids. Aug 14.

24,518.—(I. G. Farbenindustrie Akt.-Ges.). —Manufacture of methylene iodide. Aug. 15.

Specifications Published.

333,147.—Hooley, L. J., Thomas, J., and Scottish Dyes, Ltd.—Vat-dyestuff derivatives.

333,264.—Hercules Powder Co.—Method and apparatus for denitrating mixtures of nitric acid and sulphuric and concentrating nitric acid.

810,549.—Hansen, Dr. C. J.—Apparatus for the decomposition of thiocyanic acid and its salts.

833,212.—*Peggs, K. C.—Process of manufacture* of solid carbon dioxide.

Printed copies of the full published specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2., at the uniform price of 1/- each.

Abstract Published.

331,195.—Organo-arsenic compounds. (Parke, Davis & Co.; 2951, Atwater Street, Detroit, Michgan, U.S.A.).

Organi-arsenic compounds are prepared by *interaction of an organic arsenic acid or* salt thereof with a mercapto-carboxylic acid or salt thereof. The products posses therapeutic properties. Examples are given of the preparation of (1) sodium 3-amino-4-*hydroxyphenyl-arsenic acid—tetrathioglycollate* from 3-amino-4-hydroxyphenylarsini acid (1 mol.) and sodium thioglycollate (4 mols.); (2) sodium phenylglycinamide-4-arsenic acid (1 mol.) and sodium thioglycollate (4 mols.); (3) sodium 3-nitro-4-hydroxyphenyl-arsenic acid—dithioglycollate from 3-nitro-4-hydroxyphenylarsenic acid (1 mol.) and sodium thioglycollate (2 mols.); (4) the mono-cystein derivative of *arsanilic acid from arsanilic acid* 1 (mol.) and cystein (1 mol.); (5) the mono-cystein derivative of phenylglycinamide-4-arsinic *acid from phenylglycinamide-4-arsenic* acid (1 mol.) and cystein (1 mol.). The formulae *of the products are given.* Thiosalicylic acid is also mentoned as a suitable mercapto-carboxylic acid.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

TIGON.

512,406.—Sulphur and brimstone, being chemical substances for use in manufacture.—Tigon Mining and Finance Corporation, Ltd., 705, Salisbury House, London Wall, London, E.C.2. Aug. 20th. (Associated).

LANADIN

512,989.—Chemical substances for use in degreasing leather in the course of *manufacture.*—H. Th. Bohme Aktiengesellschaft, 29, Moritzstrasse, Chemnitz, Saxony, Germany. Aug. 20th. (Associated).

CALLOGEN.

511,432.—Chemical substances for use as sizing materials in the textile industry.—H. Th. Bohme Aktiengesellschaft 29, Moritzstrasse, Cheminitz, Saxony, Germany, Aug. 20th.

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Vol. 2—June to Dec., 1860.
Vol. 3—January to June, 1861.
Vol. 4—July to December, 1861.
Vol. 5—January to June, 1862.
Vol. 6—July to December, 1862.

Address, "B.Sc.," c/o *Chemical News* Offices.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

ANNUAL MEETING AT BRISTOL, SEPTEMBER 3-10, 1930.

THE PRESIDENTIAL ADDRESS.

SIZE AND FORM IN PLANTS.

BY PROFESSOR F. O. BOWER, Sc.D., D.Sc., LL.D., F.R.S.,
PRESIDENT OF THE ASSOCIATION.

(*Concluded from page* 149.)

This is not the place for a recital of the details of elaboration of the wood which have been observed and measured. It must suffice to state in general terms how primitive woody plants have met the difficulty in the absence of cambial thickening. The starting point is a minute cylindrical strand composed of dead tracheids only, Some primitive types show nothing more than a conical enlargement of this upwards, with the cells more numerous than before. The approach of a locomotive at speed along a straight track may visually suggest such increase in size without change of form; successive photographs of it might be compared with successive sections of those simple stems enlarging upwards without change of plan. The largest examples of this are found in some of the early club mosses and ferns, in which there is an enlarging solid woody core. But for want of resource in this and other features they have paid the penalty of death. Most plants having this crude structure are known only as fossils, and no really large vascular plant lives to-day which shows it. Under present conditions it is only where the size is small that a simple mass of dead tracheids seems to be effective for water-transit. Thus we see that simple enlargement without change of form does not suffice.

In more resourceful plants a remedy is found in elaboration of the form and constitution of the primary wood. The changes which actually appear in it, as the size of the individual or of the race increases, are very various, but they all tend towards making the wood a living whole. The most efficient state would be that in which each dead woody cell or element faces upon one or more living cells, and this structure is approached in modern types of wood. In tracing the steps which have led towards it, whether in the fossil story or in the individual life of plants, we follow up an evolutionary history of high functional import. Actual measurements and calculations have shown in living plants the advantage that follows. It has been found that changes in the elaboration of form and structure of the primary woody column have saved, in specific instances, about 50 per cent. of the contingent loss in that proportion of presentation-surface to living tissue which would have followed if a simple cylindrical core had been retained. The structural changes do not, it is true, maintain the full original ratio of surface to bulk, but it may well be that saving even half of the contingent loss would bridge the acute risk and lead to survival.

The moulding and subdivision of the primary conducting tracts as a whole, or of the woody masses which they contain present the most varied features. Thei contours often appear arbitrary and eve irrational, so long as no underlying prin ciple is apprehended. They have presente a standing problem to anatomists. Bu when it is realised that as the size increase there is a physiological advantage in an elaboration of form whatsoever, a rationa explanation is at hand. The variety of th forms assumed suggests the common prin ciple underlying them all, which is tha thereby a due proportion of presentation surface tends to be maintained.

One of the simplest and most frequen examples of such elaboration of form i that of the fluted column, which in trans verse section gives the familiar stellat figure characteristic of roots. It is als seen in many stems, and is described a 'radical.' Where the part is small th woody strand is roughly cylindrical, bu where larger it often becomes fluted, wit varying number and depth of the flanges In many instances the ratio of their num ber to the diameter of the whole tract i approximately constant. The structure i in fact adjusted to the size. This is so i roots generally, in leafy stems and in leaf less rhizomes—and a similar size-relation i even found in the fluted chloroplasts o certain Algæ. In all of these an obviou risk following an increase in size tends t be eliminated, viz., an undue loss of pro portion of surface to bulk.

The somewhat technical facts thus briefl described may be taken as examples of relation of form to size which is ver

general. They suggest the existence of a 'size-factor,' which is effective in determining form. The susceptibility to its influence resides in the part that shows the results. The internal contours are defined *ab initio*, instead of coming into existence during the course of development, as is the case with the convolutions of the mammalian brain. In the stem and roots of vascular plants the fully-matured conducting tracts may be traced upwards, with their outlines already defined, through successive stages of youth towards the growing point, which has been their source. Their form may be seen already outlined in its young tissue closely short of the extreme tip. This fact suggests that the susceptibility to the size-factor resides in the growing point itself, for immediately below it those tracts possess that form which will aid their function when they are fully developed.

Of all the factors that contribute to the determination of form in growing organisms there is none so constant and inevitable in its incidence as this size-relation. Its operation becomes manifest with the very first signs of differentiation of the embryonic tissues. The effects of other factors that influence form, such as gravity, light, temperature, contact and the rest appear later in point of time. Their influence is liable to diminish as the organism reacts to them by curvature or otherwise, and to vanish when the reaction is completed. Under experiment they may be controlled or even inhibited. But the operation of the size-factor is insistent; it cannot be avoided either under conditions of nature or by experiment, though the size itself may be varied under conditions of nutrition and the permeability of the presentation-surfaces may not be constant, with results as yet unknown. When we reflect that all acquisition of nourishment and transit of material in plants of primary construction is carried out through limiting surfaces, the essential importance of the size-factor is evident, for upon its influence the proportion of each presentation-surface itself depends.

The evidence that size itself is, among other factors, a determinant of form rests upon the constancy with which, in an enlarging organism, changes of primary form tend to maintain a due area of presentation-surface such as active transit demands. That evidence has been derived chiefly from the conducting tracts of primary individuals as they enlarge conically upwards, and from parts belonging to distinct categories, also from comparison of different individuals not necessarily of close alliance. Very cogent evidence lies in the variety of the changes of form by which the same end is attained. Finally the converse facts bring conviction when, as often happens, a distal diminution of size in stem or leaf is accompanied by simplification along lines roughly the converse of those that follow increase. All this shows that a real relation exists between size and primary form. The term 'size-factor' has been used to connote that influence which affects form in relation to size, but without defining it except by its results. Nevertheless, we have seen that its action may be located in near proximity to the growing point, or in the embryo itself. It has not, however, been found possible to assign to that effect an immediate cause. The attitude thus adopted towards an undoubted factor seems justified by the broad logic of science, and by the practice of its highest votaries. When Newton put together his great physical synthesis he pointed out at the close of the *Principia* that the cause of gravitational force was unknown. 'Hitherto I have not been able to discover,' he said, 'the cause of these properties of gravity from phænomena, and I frame no hypotheses.' Likewise, in its own more restricted field of botanical phenomena, the size-factor may be recognised as effective in development, though the immediate cause of its effectiveness is still unknown.

The position thus adopted assumes the shoot to be a unit, not a congeries of 'phytons.' The elaboration of its form, whether external or internal, would be a function of the increase in size of that unit, and the result would tend to maintain the adequacy of the presentation-surfaces. This conception of the shoot and its parts would accord with the views of General Smuts, as stated in his remarkable work on 'Holism,' published in 1926. Many present here to-day will have heard his Address in Cape Town last year, when opening the discussion on 'The Nature of Life.' All will value this masterly statement in brief of his theory. I suggest

that the operation of the size-factor, whether in relation to external leaf-development or in the elaboration of internal conducting tracts, illustrates that 'measure of self-direction' ascribed by him to every living organism ('Holism,' p. 98).

The discussion of the problem of size and form in plants, which has occupied our attention thus far this evening, raises questions of profound significance in the sphere of pure botany. There is, however, another interest inherent in the study of plants beyond that of pure science. I mean botany as applied to the needs of man. To-day this touches human life more closely than ever before. Every meal we eat, many of the clothes we wear, timber, rubber, a whole volume in itself; the drugs, narcotics, dyes and scents, and most of that vast tale of accessories that ameliorate life, depend for their supply, quality and often for their existence upon the skilled work of the botanical expert. He is trained in our schools and universities. His experience there is perfected by work on farms and plantations, in forests and in factories, often by adventurous life abroad. It would be superfluous for me to enter into detail on such matters, for happily the director of Kew presides over the botanical section, and he can speak with the fullest knowledge on the application of botanical science to modern life.

Government Departments are now linked more closely than ever with universities and technical colleges by the golden chain of grants. The botanical institutes that have sprung from this joint source are mostly focussed at such centres as Kew and South Kensington, Cambridge and Oxford, Harpenden and Merton, Long Ashton and Corstorphine, Plymouth and Millport, with important outliers such as Dehra Dun in India, the Imperial College of Tropical Agriculture in Trinidad, and the Research Station at Amani, East Africa; while similar stations are to be found in Canada, at the Cape, in Australia and New Zealand. Their activities are as diverse as their position. Agriculture, forestry, plant-breeding and distribution, seed-testing, mycology and plant pathology —these are but a few of the headings under which Applied Botany is now pursued; and a duly qualified staff is required for each. Kew itself, thanks to the foresight of the Empire Marketing Board, is developing ever more and more as a co-ordinating centre for the whole Empire. Highly specialised study such as this has sprung into existence in the last half-century. As regards Britain, its origin may be traced to the biological laboratory of the old Normal School of Science at South Kensington, where biological research was revived under Huxley and Thiselton-Dyer.

The first botanist there trained in pure science who turned the newly acquired vision to practical account in the interests of the Empire was Marshall Ward. For two years he investigated the coffee disease that had half ruined Ceylon. It is a long step from this individual effort in the East to the firmly established and efficient Mycological Bureau, recently housed at Kew in a new building devoted to the world-wide study of the fungal diseases of plants. Such advance along a single line of Applied Botany may be taken as an index of the progress from simple beginnings in pure botany to that wide-spread attack now being made upon the economic problems that face Imperial Agriculture. The history of it thus briefly suggested may be read as a parable, showing how natural is the progression from the study of pure science to its practical application. For there is no real distinction between pure and applied science. As Huxley told us long ago, 'What people call applied science is nothing but the application of pure science to particular problems."

At the moment there is an unprecedented demand for botanical specialists to fill investigational and advisory posts at home and abroad, and there is a shortage of applicants. The realisation of this will doubtless be transmitted through the universities and colleges to the schools of the country and lead to an increased supply. On the other hand, it lies with the Government to react as other markets do in taking steps to equalise supply and demand. A condition of the success of a specialist will always be a thorough foundation upon pure science, and this will be fully realised in the selection of candidates. Government, whether at home

or in the wider Imperial field, can make no better investment than by the engagement of the best scientific experts available. In respect of botany this has been attested by many well-known instances.

Some reference will naturally be expected here to the remarkable Address given by Sir William Crookes in 1898, when the Association last met in Bristol. He then forecast that, in view of the increase in unit-consumption since 1871 and the low average of acre-yield, 'wheat cannot long retain its dominant position among the foodstuffs of the civilised world. Should all the wheat-growing countries add to their area to the utmost capacity, on the most careful calculation the yield would give us only just enough to supply the increase of population among bread-eaters till the year 1931. The details of the impending catastrophe,' he remarked, 'no one can predict, but its general direction is obvious enough.' The problem is one of applied botany, with a setting of world economics and a core of physical chemistry. After raising the spectre of wheat-shortage before the eyes of his audience of 1898, Crookes laid it again by the comforting words, 'The future can take care of itself. The artificial production of nitrate is clearly within view, and by its aid the land devoted to wheat can be brought up to the 30 bushels per acre standard.' We who are living within a few months of the fateful year of 1931 are unaware of any wheat-shortage. Sir William Crookes' forecast of 1898 as to the advance in the production of combined nitrogen has been fully realised. Artificial fertilisers are not in view only, but at hand and in mass. Moreover the northern limit of successful wheat-culture has been greatly extended by the production of new strains with ever shortening period between sowing and reaping, while the establishment of new varieties is extending the productive area in South and West Australia into regions where the rainfall is of short duration, and restricted in amount. The future, since 1898, has indeed taken care of itself; so that, notwithstanding the warning of so great a man as Sir William Crookes, the wheat- eating public is still able to sleep well at night so far as the wheat-shortage is concerned. What better example than this could we desire, not only of the importance of applied botany, but as showing also how its advance follows on research independently pursued. For the production of synthetic nitrogen, which has now become a commercial proposition, and the improvement of the strains of wheat by selective breeding along Mendelian lines, are both involved in solving this crucial question of food-supply. And both owe their origin to advances in pure science.

In conclusion, we shall all be conscious of the fact that a most distinguished former president of the Association has lately passed away, one who more than any man has influenced the policy of government in relation to science. I mean Lord Balfour. We recall how in 1904 he, so thoronghly imbued witb the spirit of his Alma Mater, presided over the meeting in Cambridge. He was distinguished as a philosopher, great as a statesman, and particularly so under the stress of war. He it was who, after peace returned, used his rare influence in transforming the war-time experiment of a committee of the Privy Council for Scientific and Industrial Research into a permanent and essential part of modern government. But this was not all. His critical, constructive and experienced mind was led to formulate a still wider plan. A Cabinet Committee for Civil Research was to be established on the lines of the Imperial Defence Committee. He designed it so as to bring the whole national administration within the range of scientific influence. The Department of Scientific and Industrial Research, so wisely kept in being after 1919, now forms part of that larger scheme. This department is responsible for making recommendations as to the expenditure of funds voted by Parliament for research, especially in relation to industry. Thus science is welcomed into the inner circle of Imperial administration. This the State owes to Lord Balfour.

And so in this hundredth year of its existence the British Association sees research recognised and fostered in the service of the State in a way never dreamed of in 1831, when a small body of enthusiasts met at York for the advancement of science. But though the individual seeker after truth may thus be involved in official harness, as of old an inner voice will yet speak to him. He will himself be as near to Nature to-day as he was in the simpler days that are gone.

HOW THE CHEMICAL PRODUCT DIFFERS ECONOMICALLY.

By Lawrence W. Bass,

Executive Assistant
Mellon Institute of Industrial Research, Pittsburgh, Pa.

Scientific Management is availing itself to an ever-increasing extent of the results of dependable statistical surveys of the industries. But at present the technique of using such materials to replace the approximate estimates or cruder guesses of previous years is in a formative stage. It seems probable that new methods will be evolved from time to time as aids to obtaining correct conceptions of various factors of production and consumption.

The ratio of wages to value added by manufacture is one apparently useful procedure for expressing an important production factor—namely, the productivity of labour—in any specific industry. It is, moreover, relatively simple, for the data are in general readily available and the computations are certainly not difficult. This method, however, does not appear to have attracted much attention. The more usual practices have been to measure productivity in terms of physical output or of total value of product. The ratio discussed in this paper possesses for many purposes an advantage over the former in that it permits to some degree a comparison between industries manufacturing different types of products, and over the latter in that one factor variable among industries—namely, material costs—is eliminated by considering the relation between wages and the sum of overheads and profit.

It is pertinent to mention here the searching study by Alford and Hannum (*Mech. Eng.*, 51, 181, 1929), which led to the formulation of the kilo man-hour as a basis for evaluating manufacturing operation. These authors undoubtedly have developed a method that will be of importance as a precise instrument of management. The ratio of wages to value added by manufacture is in a sense a modification of this method, for payroll totals are a function of man-hours, taking into account also the skill of the workers and the conditions of employment in the industry.

Results of a computation for major groups of industries of the ratio of wages to value added by manufacture, or, more briefly, added value, are presented in Table I. The most striking fact revealed by these data is the characteristic low ratio in the chemical industries. It is, of course, impossible to differentiate sharply between chemical and non-chemical manufacturing, because chemistry plays a greater or less part in every industry; indeed, even in those branches of manufacture classed as chemical in the "Census of Manufactures," whose classification scheme has been followed in the tabulation, the complexity of the chemical changes varies greatly. It appears evident, nevertheless, that, in general, those industries in which "chemical" transformations predominate—as opposed to "physical" changes, in which there occur no deep-seated alterations in the composition of the materials—are characterized as a group by the much higher value added by manufacture in proportion to labour costs. It is interesting to note also that, according to Alford and Hannum, the value of product per kilo-man-hour is very high in the case of many chemical manufactures.

The wages-added value ratio is not to be taken in any sense as a direct measure of profit. The overheads, representing a value comparable in magnitude to prime costs, vary greatly in the major industrial groups and in the individual industries. If, in a given industry, one cost component is low, other factors usually tend to counteract this effect. For example, as De Long (*Chem. & Met.*, 32, 919, 1925), has pointed out, the ratios of wages and material costs to total value of products are roughly in inverse proportion to each other. Then, again, the same author (*Chem. & Met.*, 32, 853, 1925), has shown that the capital ratio exhibits considerable variation in different types of manufactures; in the chemical industries, for instance, it is comparatively high.

The major groups of industries listed in Table I are made up of widely varying minor branches of manufacture. This diversity renders generalizations of doubtful value until more exhaustive analyses are available. It is relevant to this discussion, however, to mention that there is no obvious simple explanation of the characteristic low ratio of wages to added value in the chemical industries. Other

related aspects that have been considered in the possibility that they might throw light on this situation are the following: wages-material costs; added value-material costs; average wage rates; salaries-wages; salaries plus wages-added value. In addition, the components of the major groups of industries have been itemized. The data used for all computations were obtained from the governmental censuses of manufactures for the respective years. In all tables the groups of industries and separate industries are listed according to order of importance of total value of products.

Considering first the figures given in Table I, it is noteworthy that the ratio of wages to value added by manufacture shows a striking regularity for most of the groups, especially in view of the fact that data for pre-war and post-war years are being compared. Throughout the period analyzed, the chemical industries have a very low ratio, being second in this respect only to tobacco manufactures, which, incidentally, constitutes the least important group listed, from the standpoint of total value of products. A further qualifying consideration in respect to tobacco manufactures lies in the fact that the very low wages (and wages plus salaries, Table II), to added value ratio is largely due to the increase in overhead represented by the inclusion of internal-revenue taxes in the total value of products, and, consequently, in the value added by manufacture. It should be noted also that railroad repair shops constitute an exceptional case, because the values of products represent, in general, only the sum of the costs of materials and salaries and wages; in some cases other expense factors were included.

It appeared possible that the low wages to added value ratio in chemicals might be related to an abnormally high added value in comparison with material costs. Investigation of this point, however, showed that these industries, with a ratio of 58 per cent. in 1927, were even lower than the average for all industries, 79 per cent. The range in the groups was from foods, 36 per cent., to stone and ceramic products, 171 per cent., and tobacco manufactures, 176 per cent. Here again little change was shown in any group from the pre-war years to 1927.

Wage rates in the chemical industries are close to the average for all industries (see also Tyler's "Chemical Engineering Economics," pp. 41-48, 1926); therefore the explanation of the low wages-added value ratio cannot lie in a low payment of workers. The census statistics are not adaptable for use in computing an average wage, but a rough estimation bears this out.

It has frequently been mentioned that the ratio of salaries in the chemical industries is abnormally high, and indeed it is evident from the analysis of the data for 1925 in Table II that this assertion is true. The higher proportion of salaries, however, does not suffice to bring the ratio of wages plus salaries to added value to a high percentage in comparison with other industries. This major group is again well below the average for all industries and is second only to tobacco manufacture, which, as indicated above, represents a special case.

The low ratio of wages to added value obtains throughout the industries in the chemical group, as shown in Table III. This point is worthy of note, lest it be thought that a few very low ratios might decrease considerably an otherwise average value. This detailed analysis reveals that, although the percentages in some of the separate industries are remarkably small, even the highest are not far from the average for all industries. In a similar manner, values are given in Table IV for the more important component manufactures of the major groups listed in Table I.

From a broad consideration of all the data presented in this paper, the conclusion seems to be warranted that in the period 1914-1927 the ratio of wages to added value has remained nearly constant, though there is evidence for the belief that the increased efficiency of manufacturing operations is reflected in a slight decrease in the ratio in the more recent years. This general conclusion is apparent in the data for all industries, in the major groups of manufactures, and in the individual industries. This, then, may be taken as the normal course of manufacturing for the period.

There are a few marked exceptions to the rule, and in some cases they may be explained on the basis of profound changes in the character of the industry concerned.

The ratio of wages to added value in coke manufacture dropped from 47, in 1914, to 30, in 1923. This decrease represents the effect of the main transition from beehive ovens to byproduct practice; the two processes are widely different in their wage-added value ratios, 43 and 26, respectively, according to the data for 1923. In 1914, 57 per cent. of the total coke was produced in beehive ovens, while in 1923 only 22 per cent. was thus made. Glass manufacture presents still another example of marked decrease in the wage factor, the ratios in 1914 and 1923 being 68 and 46 per cent., respectively. This drop has resulted, of course, from increased mechanization in the industry.

A few cases are found also in which the ratio of wages to added value has increased. Two examples are meat products (slaughtering and meat packing), and cane sugar refining, with changes from 30 to 41 and from 31 to 45, respectively, between 1914 and 1923. These two industries have already been analyzed in detail by Alford (in "Recent Economic Changes in the United States," 1929, pp. 147-166), who shows that they fall in the group of manufactures that may be characterized as "not well-favoured," or, in other words, that their percentage increases in productivity per man-hour have not been of favourable magnitude during this period.

In conclusion, it is demonstrated by these facts that in the chemical industries wages and salaries are a minor cost component in comparison with other industries in regard to the value added to raw materials by the processes of manufacture. A similar relationship exists in this group between wages and material costs. The opportunity for effecting further savings in cost of manufacture in this particular field therefore appears to lie in decreasing the overheads or in employing cheaper raw materials.

In the report by Alford and Hannum already referred to, these authors emphasize the fact that but little significance should be attached to their numerical values; the important features are the relationships and relative positions in sequence. A similar caution is requested in considering the contents of the present paper. It is thought, however, that more studies of this type will so reveal the value of statistical investigations that data will become available for the formulation of definite recommendations that will be of real utility in management.

Note.—Prior to his advent at Mellon Institute in 1929, Dr. Bass had been with the Rockefeller Institute's chemistry division for four years. His broad education was gained at the Universities of Tulane, Yale, Lille and Paris, at Pasteur Institute, and as National Research Fellow in 1922-23.

THE HISTORY OF ORE TREATMENT PROCESSES IN BROKEN HILL.*

E. T. Henderson.

*From the Proceedings of the Australasian Institute of Mining and Metallurgy.

(*Continued from page* 155.)

This patent was the basis of improvements granted to other inventors, chief among whom were the two Elmores, who obtained patents in 1899, 1900, and 1902. These improvements were for the method of carrying out the process originally patented by Everson. These processes are known to-day as the "Bulk Oil Process."

The next step in the evolution of the flotation process was made by Charles Vincent Potter, of Melbourne, who, in 1901, patented a process for recovering sulphides from pulverised ores by treating them with hot acid solutions. No oil was used, and the sulphides were floated by gas liberated from the ore.

Unfortunately Mr. Potter masked this discovery with a long account of how to produce metallic zinc from the zinc sulphide concentrate obtained, introducing reactions which had been proved to be useless for that purpose, and consequently his discovery did not attract the attention it should have done at the time.

In 1902 much the same thing was discovered by Mr. G. D. Delprat, who found that by boiling the tailing produced from the ore-dressing mills with a solution of nitre cake acid (sodium sulphate) the sulphides floated to the surface, and could be removed by skimming, leaving the clean gangue at the bottom of the vessel used.

This experiment was conducted by the late Mr. A. D. Carmichael, experimental chemist to the Proprietary company, under instructions from Mr. Delprat. The initial object of the experiment was to dissolve the zinc.

It might be as well to enlarge on this

discovery, as it was of such importance to Broken Hill, also because it is rather amusing as well as instructive.

Mr. Delprat used to say that "you should never take anything you read in text books for granted, but you should try it for yourself," and it was by sticking to this principle that the discovery was made. Mr. Carmichael was a very clever chemist, and had done a lot of work on the recovery of zinc from the ores by chemical means, but had not produced a commercial success. He was up against a dead end when Mr. Delprat told him to try to dissolve the zinc out, and to try nitre cake for this purpose, and so perhaps use up the accumulated stocks of it. Mr. Carmichael, knowing that blende was unattacked by this substance, was not enthusiastic. However, Mr. Delprat told him to go and try it, and he did so. He took a beaker and boiled up a solution of nitre cake, placed the middling in it and boiled it. He then went back to Mr. Delprat and said: "There, I told you so; the zinc won't go into solution, and it won't even go under the solution, but floats on the top." Mr. Delprat had a look at it, and on lifting up the beaker saw the clean gangue on the bottom and the blende floating. "That will do very nicely," said he. "It may not go into solution, but we can separate it in this way."

This method of concentrating the sulphides was thought to be quite new, and protection was obtained immediately. Experimental work was at once put in hand to devise means for carrying it out on a large scale. This was no easy thing to do. Nearly boiling acid solutions had to be handled in large quantities and materials found to withstand it.

Copper at first suggested itself, and for several months the separation of the blende from the gangue was made in copper pans, heated underneath with gas. It was found that these pans were rapidly attacked by the solution at the air-water line, due to the copper oxidising and then going into solution.

Wooden boxes lined with lead were then tried. The solution was heated by means of steam in a large vat, and then flowed into these wooden lead-lined boxes. The zinc-bearing sands were added to the hot solution and the zinc floated and was carried away by the overflow, while the clean sands were discharged through a hole in the bottom of the box. Finally cast iron replaced the wooden boxes and all the copper pipes were replaced by cast iron. These were rapidly attacked at first, but, after a few hours, the surface became covered with carbon from the iron and the action ceased altogether.

This was about the stage reached in the development of the process when the company holding Mr. Potter's patents started an action for infringement.

It was evident from Potter's specification that the process described could not be worked, so the Proprietary Co. contested the case.

This proved to be the biggest patent case ever heard in Australia. The Proprietary won in the lower Court and again in the Supreme Court, and the case was finally settled by the Potter people allowing the Proprietary to use the Potter and Delprat patents free of royalty, while Potter's received the combine patents so that they could collect royalty from other users.

In 1904 flotation plants were erected on Block 14 and the Central mine. Block 14 worked under the Potter patent, using the Goyder Laughton separating machine. This was made of copper and suffered the same fate as the copper pans on the Proprietary.

After numerous failures they adopted the method which had proved successful on the Proprietary.

The Central mine worked under the Catermole patents. This was really a modification of the old Everson patent. The pulverised ore was mixed with water and oil added in such quantity that the sulphides granulated into small balls about the size of peas. The gangue was then washed out by an up current of water. The oil used was oleic acid. The patentee claimed that this substance combined the properties of an oil and an acid, and that no other acid was required. In practice, however, sulphuric acid was used. The difference between the Cattermole process and Everson's process is that Cattermole used more water and less oil.

The Cattermole process was not a flotation process, but, while in use at the Central mine, it gradually developed into a flotation process.

At first, as mentioned above, granules of sulphides were formed, which, being heavy, allowed the finer gangue to be washed away from them by an up current of water.

However, on occasions the amount of oleic acid added was not sufficient to form these granules, or only formed them partly. When this happened a lot of zinc sulphide was lost, due to the non-granulated sulphides forming a froth in the mixers and being washed away with the gangue in the separating vessel. This was a serious matter, but it led to the discovery that by using less oil still, the sulphides could all be made to float as a froth and the gangue would settle to the bottom of the separating vessel. In this way a separation was obtained which was really the reverse of the Cattermole process. This method was patented by Sulman, Pickard & Ballot in 1905, and is the basis of what is known to-day as "Froth Flotation."

This method was also thought to be something quite new at the time, but it was afterwards found that in 1903 Alcide Froment had made a similar discovery in Italy and patented it. This patent was afterwards bought by the Mineral Separation Company, who held the other patents for froth flotation.

Still another method of separating sulphides from the minerals with which they are associated was discovered in Broken Hill, viz., "Film Flotation."

In the early stages of the Delprat process a lot of trouble was experienced with the solution. The separation would take place splendidly for a while and then gradually weaken, and finally no float at all would result. Mr. A. J. F. De Bavay, who was well known even at that time as a very clever chemist, was engaged by the Broken Hill Proprietary Co. to solve the difficulty. He discovered that it was due to organic matter, present in the feed, passing into the solution and sickening it.

While engaged on this problem Mr. De Bavay noticed that the zinc concentrates which were run from the flotation vessels direct into settling vats formed cones of solids where they delivered, and that the sulphides flowing over these cones filmed on the surface of the water. That is to say, they floated in the same way as a dry needle will float if placed gently on the surface of water.

When Mr. De Bavay returned to Melbourne he started to develop this observation of his, and finally evolved a process for which he obtained a patent in 1904. This patent was the beginning of the Amalgamated Zinc (De Bavay) Limited.

Besides these flotation processes, which were discovered and developed in Broken Hill, another process was also tried, viz., the "Elmore Process." This process was tried on the Zinc Corporation. The main feature of it was that the float was produced in a chamber kept under a minus pressure, or, in other words, a partial vacuum. This process gave very promising results, but was eventually dropped in favour of the cheaper froth flotation method.

(To be concluded.)

ON THE VISCOSITY AND THE STRENGTH OF THE JELLY AND FILM OF ACETYL CELLULOSE.

By Tsuruo Araki and Minoru Kusagawa.

(Society of Chemical Industry, Japan.)

The authors have measured the jelly strength of reversible gel composed of acetyl cellulose and benzyl alcohol by A. S. Smith apparatus, and the viscosity of the dopes prepared with eight sorts of acetyl cellulose by Ostwald viscosimeter. The jelly strength of 10 per cent. acetyl cellulose-benzyl alcohol gel at 10°C. became nearly constant after 5-6 hours' cooling, and the value of the different sorts of samples from the same manufacturers were, contrary to our expectation, inversely propotional to viscosity.

On drying the acetyl celullose solutions in the mixture of anon and acetone (equal volume) on a glass plate, the thin uniform films, having the tensile strength of 6-7 Kg/mm², were obtained. From these results, however, the qualities of the acetyl-cellulose cannot be evaluated exactly.

Sort of acetyl cellulose	Jelly strength (Hg mm)	Viscosity (25°C) sec.	Film strength Kg/mm²
Unknown	25	139	6.10
Cellit L (low)	43	115	6.80
,, (medium)	36	156	6.61
,, (high) ...	22	196	6.87
Rhone	22	185	6.64
Heyden (low) ...	85	36	6.61
,, (medium)	57	52	6.48
,, (high) ...	37	58	7.60
Acetyl cellulose paper	—	—	6.61

—*Lab. of the Aichi Tokei Denki K.K., Nagoya.*

AUTOMATIC THERMOSTATIC REGULATION.

A Notable Design of Instrument.

By a Well-known Engineer.

Of great value to the chemical industries for many different operations is completely automatic regulation of temperature, especially with steam heating, although admittedly some makes of automatic temperature regulator have not been a success for various reasons.

These include complexity, liability to wear and tear, and breakdown, failure to regulate with sufficient accuracy and speed, liability to sudden failure by sticking, and tendency to choke the free steam supply in the early stages of the heating.

However, in a different category is the "Hopkinson Type R" Thermostatic Regulator for the operation of all steam heated vessels, either of the "open" or "closed" type, a production of Hopkinsons, Ltd., of Huddersfield. The arrangement consists essentially of a main valve fixed on the steam supply circuit, taking the place of an ordinary valve, which is provided with a special automatic control arrangement operating by the expansion of a liquid or gas in a hermetically closed system. This latter comprises a closed chamber having a diaphragm operated by the pressure from the thermostatic bulb or tube in the vessel, which controls a small pilot valve working against a spring, this pilot valve opening or closing the main steam supply valve below in the pipe. The thermostate bulb in the steam heated vessel, generally in the shape of a wide diameter non-corrodible nickel alloy tube about 8ft. 0in. long, is connected by flexible tubing of any length to the diaphragm chamber of the thermostatic regulator. As the temperature in the vessel varies, the medium in the bulb expands or contracts and causes the diaphragm to move accordingly, and this operates the spring balanced pilot valve in turn, and the latter opens or closes the main steam valve. The whole arrangement is extremely sensitive, so that if the temperature in the vessel rises very slightly above some predetermined figure, then the medium in the thermostatic bulb expands, the diaphragm operates the pilot valve, and the latter slightly closes the steam valve, thus reducing the temperature.

sensitive, "balance," responding to the

Similarly, the reverse action takes place with a slight lowering of the temperature in the vessel, and the main steam supply valve is in a constant state of extremely slightest alteration of temperature, and adjusting the steam supply accordingly.

One of the most important points is the use of a pilot valve, as all devices to control a main steam valve direct from a diaphragm or other arrangement are not powerful enough to give a positive, accurate, and automatic regulation. Also by this means a single seated main steam valve is used, which closes dead tight at the correct temperature, much superior to the usual double seated value employed for the purpose.

Very important also is that the valve opens full bore and remains so until within a few degrees of the desired figure, and there is therefore no choking of the steam and severe slowing down of the heating action, such as in heating tanks or vats of liquid that results with many types of automatic regulator. Further, a single diaphragm only is necessary which cannot be strained by excessive temperature or affected by heat radiation from the main valve body.

The whole design is a very fine piece of work, the valve being of the firm's well-known high-grade quality, bronze, cast-iron, steel, or other metal, as required, with resistant non-corrodable "Platnum" valves and seats, as well as pilot valve stem, and bronze or nickel alloy piston and cylinder.

CANADA'S ASSETS.

A Report on the "National Wealth of Canada and its Provinces," just issued by the Dominion Bureau of Statistics, contains much valuable information for those interested in that country.

The total value of properties of every description in the Dominion, exclusive of undeveloped natural resources, amounts to £5,780,000,000, as compared with an estimate in the previous year of £5,533,000,000, while the total for 1921 was £4,489,000,000.

Ontario ranked first among the various provinces with estimated aggregate property values amounting to £1,978,000,000, or 34 per cent. of the total wealth of the country. Quebec was second with £1,960,000,000, or 25 per cent., and Saskatchewan was third with £615,000,000, or 10 per cent. of the whole.

GENERAL NOTES

HIGH CALORIFIC VALUE OF LONDON GAS.

Tests by the official referees show that the gas supplied to London householders during the past quarter was in every case of a higher calorific value than that actually declared by the six metropolitan companies.

South Londoners reaped the greatest benefit by receiving gas with the highest heating properties, which was produced by the South Metropolitan Gas Company and the South Suburban Gas Company.

The official figures of the Gas Referees are as follows:—

South Metropolitan Gas Company.—561.2 B.Th.U. (declared calorific value 560 B.Th.U.).

South Suburban Gas Company.—550.7 and (from (May 15) 563.4 B.Th.U.) (declared calorific values, 550 and 560 B.Th.U.).

Gas Light and Coke Company.—503.3 B.Th.U. (declared calorific value, 500 B.Th.U.).

Commercial Gas Company. — 502.9 B.Th.U. (declared calorifie value, 500 B.Th.U.).

Tottenham and District Gas Company.— 502.7 B.Th.U. (declared calorific value, 500 B.Th.U.).

Wandsworth, Wimbledon, and Epsom District Gas Company.—472.3 B.Th.U. (declared calorific value, 470 B.Th.U.).

SURVEY OPERATIONS BY GEODETIC ENGINEERS.

As in other years the activities of the Geodetic Survey of Canada, Department of the Interior, for 1930, will be scattered over different areas of the Dominion and will embrace many and diverse phases. These operations will, as always, tend towards the welfare and benefit of the country because, by accurately determining the latitudes, longitudes, and elevations of many points in the wide expanse of Canadian territory, a basis is created for the construction of railways, canals, power plants, and kindred undertakings.

It is of interest to note that the United States Coast and Geodetic Survey and the United States Geological Survey have recently embarked upon a greatly augmented programme of levelling and in this connection the latter organization has requested the Department of the Interior to have the Geodetic Survey of Canada extend lines of levels to the international boundary between Quebec and Maine and between British Columbia and Washington, in order to tie together the levelling of both countries. Efforts will be made to do this during the course of the season.

On Vancouver island precise level operations will be inaugurated from Nanaimo along the Esquimalt and Nanaimo Railway on the east coast and will be extended westerly to Port Alberni. Work on the completion of a loop of triangulation through central British Columbia and up the Fraser River valley will be carried on this year. It is expected that this loop will be completed in 1931 or 1932, and it will serve a long felt want by providing a basis for detailed map surveys.

Triangulation operations will also be carried on in the Prairie Provinces to complete a loop north of the international boundary, embracing such places as Calgary, Edmonton, Prince Albert, Saskatoon, and Regina. An extension of this triangulation net will also be commenced at Prince Albert.

The erection of fundamental bench marks, the massive concrete monuments established in public parks to preserve the determined elevations, is being prosecuted vigorously. Five of these will be erected at British Columbia points and two in the province of Quebec, as incidental to the work of the regular levelling parties. In addition a special party is being assigned to this work and will establish between fifteen and twenty fundamentals in Manitoba and north-western Ontario; such places as Winnipeg, Port Arthur, Fort William, and Sudbury, being included in the programme.

Triangulation of the important district from the town of Sault Ste. Marie eastward to Sudbury will be carried out this summer. This will be of the utmost importance to this highly mineralized region. The interests of Ontario will also be served by a precision traverse which will start from the town of Cochrane and go northward. This should prove of great value in the accurate determination of the coal areas recently discovered. Levelling

parties will be engaged in old Ontario in the vicinity of lake Simcoe, northward from Orillia to Parry Sound, and eastward from Orillia as far as Coboconk.

Triangulation operations will be carried on extensively in the province of Quebec in conjunction with the International Pulp and Paper Company for forestry purposes. This work will be in the vicinity of Parent and will run westward as far as Nottaway on the Canadian National railway, eastward as far as Joybert, and southward to Mont Laurier. It thus embraces a part of the well known interprovincial highway which is being built for touring purposes. North from the town of Parent, investigations for the laying down of triangulation will be made so as to carry geodetic work as far as lake Chibougamau, which lies in a region well known for its mineral and power developments. Quebec will also be served by level lines along the St. Lawrence river between Montreal and Three Rivers.

The study of geodetic problems, such as the deviation of the vertical and the nature of the earth's crust will be carried out along the eastern coast of New Brunswick and in Prince Edward Island.

CZECHOSLOVAK TRADE.

During July last the trade balance of the country was favourable to the extent of 213,378,000 crowns, and for the first seven months of the current year 513,415,000 crs. In the corresponding periods of 1929 the trade balance was an adverse one.

FRENCH TRADE, JANUARY—JULY.

Returns for the first seven months of 1930 show that imports amounted in value to 30,971 million francs, as against 35,208 million frs. in the same period of 1929, a reduction of 4,237 million frs., while exports totalled 26,193 million frs. and 28,974 million frs. respectively, a decline of 2,781 million frs.

GERMAN FOREIGN TRADE.

A brief review is given of Germany's trade in July. During the first seven months of the current year exports exceeded imports by 850 million marks. Reparation deliveries in kind in July amounted to 55 million mks., as against 52 million marks in June.

DWINDLING BITUMEN IMPORTS.

As the result of the increased use of British tar on our roads, the amount of foreign bitumen imported into this country is steadily declining.

Last month only 14,287 tons were imported from the United States, Mexico, and other foreign countries, as compared with 20,500 tons for the same period last year, and 23,670 in 1928.

During the first seven months of this year, nearly 113,000 tons were imported, representing a sum of £543,000, which might otherwise have gone to support home industries.

Proceedings and Notices of Societies

THE INSTITUTE OF METALS.
NINTH AUTUMN LECTURE,

By D. Hanson, D.Sc.,
(Vice-President),
(Professor of Metallurgy, University of Birmingham),
ON
"The Use of Non-Ferrous Metals in The Aeronautical Industry,"

Delivered on Tuesday, 9th September, at the Annual General Meeting, Southampton.

While it is perhaps true that the first airships and aeroplanes owed little to the use of non-ferrous metals, the present state of aerial transport is in large measure due to the development of suitable alloys and their use in aircraft construction in large quantities. Metals first entered into aircraft in appreciable quantities in the construction of the engines, and the modern high-powered units of low weight owe much to the extensive employment of non-ferrous alloys. More recently, improvements both in design and in materials have made possible the development of strong reliable all-metal structures, suitable both for aeroplanes and airships. The alloys used must be strong for their weight; this requirement is fulfilled by some of the alloy steels, and by the high grade aluminium and magnesium alloys, but the steels are at some disadvantage owing to their greater density, which prevents their use in many directions owing to the thin sections that would be required to take

advantage of their greater strength. The non-ferrous alloys also possess the advantages that they can readily be used as die-castings, forgings, stampings, and so on, and lend themselves more readily to the methods of standardised production that are already being adopted, and will become essential as popular flying extends.

Perhaps the most notable feature in regard to aluminium alloys is the extent to which heat-treatment is employed in developing their useful properties. All the important wrought alloys are used in a heat-treated condition, and there is a growing tendency to use castings similarly manufactured, and important developments have recently been made in both types of alloy.

The use of magnesium alloys, if of more recent origin, is rapidly extending. Improvements in melting and casting methods, as well as the discovery of new alloys, have contributed to this extension and there are already indications that the application of the processes of heat-treatment in suitable instances, as is done for aluminium alloys, will lead to further improvements. There is every indication that magnesium alloys will enter largely into aircraft construction in the future.

The development of rustless iron and nickel alloys will also be watched with interest, as they may well find application on account of their resistance to corrosion, although there are many directions in which the alloys of low density are not likely to be displaced.

"ROLLED GOLD: ITS ORIGIN AND DEVELOPMENT,"
By ERNEST A. SMITH, A.R.S.M., Member (Sheffield),
presented on Wednesday, 10th September.

The paper deals briefly with the history of the rolled-gold industry from its beginning in Birmingham, in 1817, until the present time. Development has been gradual, but to-day the industry forms an important branch of the imitation jewellery trade, of which Birmingham is one of the most important centres. Since 1841 rolled gold has had to compete with electro-gilded articles of jewellery. A short account is given of the methods in use for distinguishing between rolled gold and gilded materials.

The modern methods of manufacture are briefly described. In the final section is given the legal definition of rolled gold and its allied materials.

"GAS REMOVAL AND GRAIN REFINEMENT OF ALUMINIUM ALLOYS,"
By W. ROSENHAIN, D.Sc., F.Inst.Met., F.R.S., Past-President (Teddington), J. D. GROGAN, B.A., Member (Teddington), and T. H. SCHOFIELD, M.Sc., Member (Teddington), presented on Wednesday, 10th September.

A number of selected volatile chlorides have been passed into molten aluminium and certain alloys. All were found to be efficacious in removing dissolved gas from the metal. Some, particularly titanium tetrachloride, also produce a marked reduction in grain-size. The reduction of grain-size occurs also when titanium is added to aluminium in the form of titanium-aluminium alloy produced by the "Thermit" process.

"PRESSURE DIE-CAST ALUMINIUM ALLOY TEST-PIECES,"
by J. D. GROGAN, B.A., Member (Teddington), presented on Wednesday, 10th September.

This paper reports an investigation of the mechanical strength of certain aluminium alloys when pressure cast in the form of small tensile test-pieces. The behaviour of selected alloys when subjected to the attack of molten aluminium alloy and the method of entry of metal under pressure into a simple cylindrical mould are described. Results of tests of pressure die-cast tensile test-pieces indicate that, if certain serious technical difficulties can be overcome, the pressure casting process will yield products of excellent mechanical properties.

NOTICES OF BOOKS.

"The Theory of Heat Engines." By J. S. HALDANE, C.H., F.R.S. Pp. XIII-120. London: Oliver and Boyd. 1930. Price 6s.

In 1928, J. S. Haldene in his book, "Gases and Liquids," devoted two chapters to the theory of heat-engines and muscular contraction, but since subsequently discovered, that he failed to do justice to the possibilities of the steam-

engine and also that some of the points dealt with required expansion.

He has endeavoured in this book to give a theoretical account of heat-engines as they actually exist or may exist, taking into consideration essential facts well known to engineers.

If the conclusions reached in this book as to the potential thermal efficiency of steam engines as compared with that of internal combustion engines are correct, it becomes evident that coal in the solid state is mnch more valuable as a source power than has yet been realised. For countries such as the British Empire, which possess large supplies of coal, but little oil, this is a matter of considerable importance. Assuming the rôle of prophet, he predicts that we might look forward to a great development of the engine burning either coal or crude heavy oil as its fuel, and of the power so generated.

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NOTICE.—Owing to absence on holidays of the responsible persons, some of the proofs of last week's issue escaped correction, for which we apologise to our readers.

THE SIR JOHN CASS TECHNICAL INSTITUTE.

The new session of the Sir John Cass Technical Institute, Jewry Street, Aldgate, London, E.C.3, which extends over 36 weeks, begins on Monday, September 22nd, and students will be enrolled during the preceding week.

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New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

24,917.—(I. G. Farbenindustrie Akt.-Ges.).—Manufacture of indigoid dyestuffs of the anthraquinone series. Aug. 20.

24,937.—(I. G. Farbenindustrie Akt.-Ges.).—Manufacture of hydrogen. Aug. 20.

Specifications Published.

338,568.—(I. G. Farbenindustrie Akt.-Ges.).—Manufacture and production of derivatives of benzanthrone.

333,666.—(I. G. Farbenindustrie Akt.-Ges.).—Manufacture and production of derivatives of napthalene.

Printed copies of the full Published Specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, at the uniform price of 1s. each.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

MERCEROL.

514,649.—Chemical substances used in manufactures, photography, or philosophical research, and anti-corrosives.—Chemical Works, formerly Sandoz, also trading as Chemische Fabrik Vormals Sandoz, and as Fabrique De Produits Chimques Ci-Devant Sandoz, 60, Fabrikstrasse, Basle, Switzerland. Aug. 27th. (Associated).

VULCATEX.

514,716.—Chemical substances used in manufactures, photography, or philosophical research, and anti-corrosives.—British Dyestuffs Corporation, Ltd., Hexagon House, Blackley, Manchester. Aug. 27th. (Associated.)

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NOTICE TO AUTHORS & CORRESPONDENTS

Contributions for publication either as original articles or in the correspondence columns are welcomed by the Editor of *The Chemical News*.

They must be accompanied by the contributors' full names and addresses, not necessarily for publication, but as an indication of good faith. If a reply is needed or if it is desired that a manuscript which is not accepted for publication be returned, a stamped addressed envelope should be enclosed.

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BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

SECTION B.—CHEMISTRY

A STATE EXPERIMENT IN CHEMICAL RESEARCH.

By PROF. G. T. MORGAN, O.B.E., D.Sc., F.R.S., *President of the Section.*

At the Bristol meeting of 1875 my predecessor, Prof. A. G. Vernon Harcourt, spoke to this section on the teaching of chemistry, and in the course of his very inspiring address he remarked that "the science of chemistry would advance more rapidly if it were possible to organise chemists into working parties having each a definite region to explore," and he went on to inquire "is such an organisation in any degree possible?"

I propose this morning to describe the attempt recently made by a department of State, namely, the Department of Scientific and Industrial Research, to give effect to Prof. Vernon Harcourt's prophetic vision. The answer to this question is in the affirmative. Such an organisation is in some degree possible, and has actually become an accomplished fact. I must, however, leave for one of my successors in this Chair the further inquiry, Can such an organisation become permanent and still retain its primary and paramount function of chemical exploration,

ORIGIN OF THE CHEMICAL RESEARCH LABORATORY.

The work of the Department of Scientific and Industrial Research began in 1915, and during the ensuing ten years the Department had at various times become interested in investigations of a chemical nature, such, for example, as (1) large-scale researches on the chlorination of methane, (2) large-scale researches on the production of formaldehyde, (3) investigations on the manufacture of chemical products from fish residues, (5) general researches on the corrosion of metals, (6) general researches on high-pressure reactions, including the reactions between carbon monoxide and hydrogen.

These investigations, which were undertaken mainly under the auspices of the Chemistry Co-ordinating Research Board, were carried out by isolated groups of workers, who were often located in widely separated laboratories. One group studied the corrosion of metals at the Royal School of Mines, another examined fish products in the Imperial College of Science and Technology, whereas a third experimented on the chlorination of methane and on the recovery of formaldehyde from waste liquors of wool-scouring at the Royal Naval Cordite Factory in Dorsetshire.

It soon became evident that some increase in economy and efficiency could be attained by bringing together under one roof these scattered groups of workers who would receive encouragement and stimulus by becoming part of a more centralised scientific organisation.

A suitable site was chosen on the Bushy Park Estate in close proximity to the National Physical Laboratory and the Admiralty Research Laboratory, and here in 1924 the building of a chemical laboratory was commenced on a plot of land allowing scope for future expansion.

The original plans drawn out by the architects of H.M. Office of Works made provision for three laboratory units each of rectangular shape and built round four sides of a central courtyard. The front and back of the hollow rectangle consist of two two-storey blocks; the front block designed for general and special small scale labratories with the necessary offices, the back block arranged to accommodate workshops, service rooms and heating plant. The two sides of the rectangle, which consist of two single-storey blocks with saw-toothed roofs, north lighted and with a clear head room of about sixteen feet, give adequate space for large-scale laboratories.

These buildings are constructed in steel and brick and so arranged that partitions can be readily removed for alterations or extensions. In the two-storey blocks the floors and roofs are formed of hollow concrete tubes, but in the engineering section of the building, where heavy superloading had to be considered, a more rigid type of construction in steel and concrete floors was adopted. In the interest of economy, plaster and other relatively expensive internal finishings were omitted wherever possible, and distemper or paint being applied to flush-pointed brickwork. The floors were covered with stout cork carpet, laid directly on the cement rendering.

The laboratories are equipped with specially designed fittings, the framing and fronts are of stained British Columbia pine, whereas the bench tops and other portions subjected to hard wear are in teak or Iroko wood. The internal drainage to laboratory

sinks is effected by open stone-ware three-quarter circular channels finished with acid-resisting glaze. Wherever exposed internally, structural steel and joiners' work are coated with acid-resisting paint. The benches of small scale and special laboratories carry five services—gas, water, steam, vacuum and compressed air. Each room is amply supplied with electric current (D.C.).

In conformity with the neighbouring buildings of the National Physical Laboratory, a simple modern Georgian style was adopted in the design of the elevations of the new laboratory. The buildings are faced externally with multi-stone sand face bricks, reconstructed Portland stone being used sparingly in cornices, string courses, and entrance doorways.

The construction of one of these units was started towards the end of 1924,, and when scientific work was commenced in the autumn of 1925 about one-third of the first unit had been built, although actually only one room was ready for occupation. The fitting of the remaining laboratories and workshop was, however, rapidly effected, and by the end of 1926 the whole of the available space was fully occupied, the staff then consisting of the superintendent and ten chemists, with one engineering assistant and ten members of the artisan, clerical and general staff.

The frontage to the half unit was commenced in November, 1927 and completed for occupation by Easter, 1928, and the staff was then increased gradually to its present total strength of about sixty.

Beyond a small addition for stores and workrooms completed in 1929 there has been no further extension of the building, so that after five years rather more than half of the first unit has been erected and put into commission. There has been no attempt to force the growth of this State laboratory, which is still to be regarded as being at an experimental stage.

Administration and Control.

The work of the laboratory is conducted under the guidance of a Chemistry Research Board, which has taken over certain functions of the older Chemistry Co-ordinating Research Board. This Board is charged with the duty of advising the Department on the programme of work to be undertaken at the laboratory and of exercising general supervision over its execution.

At the outset executive control was exercised by a part-time director of chemical research and a whole-time superintendent; but from 1927 to the present this responsibility has been vested in a whole-time director.

Programme of Research.

At the present time the scientific and technical staffs are occupied on six specific items of research prescribed on the advice of the Chemistry Research Board, and "working parties of exploration" are detailed to these mandated researches by the Director.

Now since these explorations were started at different times and in various circumstances, I propose to describe them simply in the order in which they have come under my notice. This arrangement is purely chronological, and has no bearing whatsoever on any order of merit or importance. Moreover, it is essential to success in any research laboratory that each researcher should regard his own investigations as the most interesting and important in the world.

When thus arranged, the six mandated researches are as follows: synthetic resins, low temperature tar, high-pressure chemistry, corrosion of metals, chemotherapy and research on water pollution. In addition to these prescribed investigations a certain amount of general research is carried out at the discretion of the Director.

Synthetic Resins.

The growing importance of synthetic resins in chemical industry is gauged by the fact that the world's production of formaldehyde resins which was of the order of 9,000 tons in 1921 had increased to 13,000 tons in 1926, of which Great Britain was responsible for 16 per cent. as against 40, 24 and 8 per cent. derived respectively from the United States, Germany and France, other countries accounting for the remaining 12 per cent. Such resins are employed in the manufacture of moulding powders and electrical components. The production by industrially available means of resins of high dielectric capacity is a matter of national importance, and it was with this objective that an investigation of phenol-formaldehyde resins was begun even before the central laboratory was ready for occupation.

In May, 1925, a chemist was appointed to work at this problem in the University of Birmingham, and attention was directed to formaldehyde condensations with homologues of phenol, namely, the cresols and xylenols. Experience soon showed that *m*-cresol and 1 : 3 : 5-xylenol were espec-

ially suitable for such condensations which in the case of the former phenol were extended to a semi-works scale.

According to the nature of the catalyst *employed, phenol-formaldehyde* condensations yield, in general, one or other of two distinct types of resin. Alkaline catalysts lead to the production of resins of " bakelite " type, which, although originally soluble and fusible, yet possess the property of moulding under the combined effect of heat and pressure into hard insoluble and infusible products constituting by far the more important group of phenol-formaldehyde resins.

Acid catalysts favour the production of resins of " novolak " type, which, being permanently soluble and fusible, are utilised principally as shellac substitutes in lacquers and varnishes.

Alkaline Condensations.—After successful small-scale tests, alkaline condensations of formaldehyde were performed on 24lbs. of *m*-cresol, carried out under factory conditions in a plant of semi-works scale comprising a jacketed reaction vessel, reflux condensers, washing and storage tanks, drying and incorporating vessels and a hydraulic press with heated platens.

A systematic study of this alkaline condensation revealed the presence of several crystalline intermediates which precede the formation of resin. The latter was employed in the production of moulded articles and of laminated boards for electrical testing.

Acidic Condensations. — The chemical nature of formaldehyde-phenolic resins is still a matter of speculation, but the appearance of crystalline intermediates in the early stages of acidic condensations is of interest as denoting the course of these reactions. During these researches several crystalline intermediate products were isolated for the first time.

FORMALDEHYDE-KETONE RESINS.

In the foregoing formaldehyde-phenol condensations, acetone is sometimes used as a medium, but since in the presence of alkalis this solvent condenses with formaldehyde to yield resin, the chemistry of the process has been elucidated by a study of the interaction of formaldehyde and the ketones under alkaline conditions. As the homologous series is ascended the formation of resin decreases. Acetone yields mainly resin and small proportions of γ-ketobutanol,, $CH_3 \cdot CO \cdot CH_2 \cdot CH_2 \cdot OH$ and of the tetrahydropyrone formed by dehydration of the tetrahydric alcohol $HO \cdot CH_2 \cdot CH_2 \cdot CO \cdot C(CH_2 \cdot OH)_3$. Methyl ethyl ketone gives considerable proportions of the following mono- and di-hydric alcohols, $CH_3 \cdot CO \cdot CH(CH_2 \cdot OH) \cdot CH_3$ and $CH_3 \cdot CO \cdot C(CH_2 \cdot OH)_2 \cdot CH_3$ with but litte resin. Diethyl ketone furnishes no resin but leads to similar mono-, di- and tri-hydric alcohols.

LOW TEMPERATURE TAR.

There is at the present time in this country no process of chemical industry which is more in the public eye than low temperature carbonisation of coal. . The matter is of supreme national importance, for the larger problems facing this mode of utilising coal are both economic and technical and turn on the exploitation to the best advantage of the resulting products: smokeless fuel, gas, aqueous liquor and tar. Now since any marked appreciation can be expected only in the case of the last of these products it follows that processes tending to an increase in the value of the tar are of fundamental interest.

During the last five years a systematic study of the chemical constituents of low temperature tar has been in progress in the Teddington laboratory and, in our experiments on this material, quantities of the order of 40 gallons have been handled in the semi-scale plant. The starting materials, supplied by H.M. Fuel Research Station as part of the Government's scheme of scientific investigation into the utilisation of our national resources of coal, consist of pedigree tars derived from coals of definite origin carbonised under carefully controlled and reproducible conditions.

It was soon found that although low temperature tar had been produced at carbonising temperatures of about 600°, yet it could not again be heated even to comparatively low temperatures—round about 150° —without undergoing considerable alterations of a chemical nature. Accordingly, distillation processes were replaced by milder methods of extraction, and the tar was not heated above 120° until its more decomposable constituents had been removed.

A representative tar from a typical bituminous coal (Kinneil coal) was heated to 120° to remove light oils and adhering aqueous liquor, and the residue extracted by systematic use of solvents to separate it into its major constituents: neutral oils and waxes, aromatic hydrocarbons, bases,

phenols and carboxylic acids. It was then noticed that each of these five main groups of products could be separated into two fractions, one portion consisting of crystalline substances conveniently termed "crystalloids," the other portion composed of amorphous resinous materials to which the name "resinoids" was applied.

The Crystalloids of Tar.

Waxes and Neutral Oils.—From the least volatile fractions of neutral oils, waxes are obtained melting over a considerable range of temperature, and X-ray analysis of the less fusible of these waxes has revealed the presence of hydrocarbon chains containing 26, 27 and 29 carbon atoms.

The neutral oils contain both saturated and unsaturated hydrocarbons and also oxygenated substances reacting with ferrichloric acid, $HFeCl_4$.

Aromatic Hydrocarbons. — Naphthalene, a characteristic major constituent of high temperature tar, is present in low temperature tar, together with β-methylnaphthalene, but only in such small proportions that they have to be separated through their picrates.

The least volatile tar oils after removal of waxes and resins deposit on cooling a material analogous to the green grease of high temperature tar. This product consists principally of the methyl derivative of anthracene, although a small proportion of this hydrocarbon itself may possibly be present. Oxidation of various fractions from this product leads to 2-methylanthraquinone, 2 : 6- and 2 : 7-dimethylanthraquinones and 2 : 3 : 6-trimethylanthraquinone. The proof of the orientation of methyl groups in these anthracene derivatives has involved the synthesis of the hydrocarbons and of their quinones (*Journ. Chem. Soc.*, 1929, 2203 and 2551).

Bases.—The volatile bases of low temperature tar are mainly tertiary amines although a small amount of aniline was detected. The following bases were isolated and purified through their crystalline mercurichlorides: pyridine, α-picoline, 2 : 4- and 2 : 6-lutidines and symmetrical collidine; quinoline and quinaldine were isolated as picrates.

Phenols.—Low temperature tars contain a high proportion of material extractable with aqueous caustic soda, but only a portion of this soluble extract consists of true phenols, the remainder is composed of non-phenolic substances which, however, dissolve in solutions of the alkaline phenolates. These non-phenolic materials are recovered from a caustic soda extract of the tar either by agitation with an organic solvent such as chloroform or more simply by saturating the alkaline extract with salt. The true phenols remaining in the alkaline solution are separated into crystalline and resinous portions by solution of the former in light petroleum. Further fractionation of the petroleum soluble phenols has led to the isolation of the following compounds: phenol, the three cresols and five of the six possible xylenols. Bacteriological examination of the phenols of low temperature tar has shown that their germicidal value increases with rise of boiling point to an optimum fraction boiling at 140-170° under 5mm. pressure. Moreover, it has been found that direct chlorination of these higher phenols of low temperature tar increases considerably their germicidal potency.

The Resinoids of Tar.

With each class of crystalloid in the low temperature tar there is present a corresponding resinoid which constitutes the least volatile portion of each major fraction. These products, which are termed respectively resinenes (neutral resins), resinamines (basic resins), resinols (phenolic resins) and resonoic acids (acidic resins), are obtained as amorphous powders after extraction of the corresponding crystalloids with petroleum or other suitable solvent. These resinous tar products are promising materials for further research from both scientific and industrial viewpoints.

An extension of the solvent method of extraction to other varieties of tar from wood peat, lignite and bituminous coal has revealed the presence in each tar of the four classes of resins, although in wood tars the amount of resinamines was very small. Coal tars produced by carbonisation at high and intermediate temperatures show considerable variations in their resin contents.

Aqueous Liquors of Coal Carbonisation.

The aqueous liquors which accompany low temperature tars have been extracted systematically with organic solvents in quantities of 30 gallons at a time, and in this way phenol, *o*-cresol, catechol and its two methyl derivatives, resorcinol and quinol have been isolated, together with a new type of resins to which the name resinolic acids has been given, as they are inter-

mediate in chemical properties between resinols and resinoic acids. Resinolic acids in the presence of ammonia are largely responsible for the dark red colour of the aqueous effluents from gasworks. These aqueous liquors have also furnished on systematic extraction aniline, pyridine and α-picoline, and the series of fatty acids ranging from formic to *n*-valeric acids.

HIGH PRESSURE CHEMISTRY.

During the past ten years increasing attention has been directed to the use of pressure as a means of facilitating the course of chemical reactions, and research on high pressure syntheses was started at the laboratory in 1926 on the recommendation of the Chemistry Co-ordinating Research Board, whose members were impressed by the possibilities revealed by the work of Patart in France and of the Badische Anilin und Soda Fabrik in Germany.

The plant required for this investigation was designed and built in the laboratory workshop, and the earliest experiments were carried out with hand compressors. Subsequently motor-driven compressors and circulators were added to the equipment. This plant ws first tried out with catalysts of the Patart type (normal or basic zinc chromate) in order to gain skill and confidence in the process. It was thus found that on passing the mixed gases (1 vol. CO, 2 vols. H_2) at the rate of 30,000 vols. per hour, measured at N.T.P. over unit volume of such a catalyst at 380° and under 200 atmospheres' pressure the hourly production of methyl alcohol was about twice the volume of catalyst space.

The addition of cobalt chromate or nitrate to the foregoing zinc chromate catalyst led to an interesting development, since with the more complex catalyst ethyl alcohol and other higher alcohols made their appearance, although methyl alcohol remained the predominant product. Small amounts of aldehydes and acids were also detected. By the use of mixed cobalt catalysts containing zinc, together with chromium or manganese, the following alcohols have been obtained in addition to methyl and ethyl alcohols : *n*-propyl, *n*-butyl, *iso*-butyl and *n*-amyl alcohols and racemoid 1-methylpropylcarbinol $CH_3.CH_2.CH(CH_3).CH_2.OH$. So far only primary alcohols have been detected. Aldehydic products have been identified as follows : formaldehyde, acetaldehyde, propadehyde, *n*-butaldehyde and also certain aldehydes arising from the condensation of the foregoing aldehydes and alcohols. Moreover, the synthetic products contain formic, acetic, propionic and *n*-butyric acids.

The addition of even small proportions of cobalt to copper-manganese oxide catalysts (Audibert type) has a marked effect on the production of ethyl alcohol and its homologues, and a similar result is noticed on replacing the cobalt in these catalysts by iron. Traces of alkali hydroxide promote the formation of higher alcohols, and in this respect potash is more efficacious than lithia.

HELIUM FROM MONAZITE SAND.

In addition to their synthetic experiments, the staff engaged on high pressure chemistry have brought to completion a research on the extraction of helium from the monazite sand conveyed to this country from Travancore for the manufacture of thoria and ceria required in the incandescent mantle industry. During this manufacture each gram of sand evolves 1 c.c. of helium at N.T.P., so that 100 tons of sand would discharge into the atmosphere approximately 100,000 litres of the gas. Our requirements of this raw material were entirely met through the kind assistance of the late Mr. Edmund White, formerly managing director of Messrs. Thorium, Ltd.

The gas was liberated by heating the monazite at 1000° in heat-resisting steel pots in a stream of carbon dioxide, and the issuing gas was passed over cupric oxide at 500° to oxidise hydrogen and carbon monoxide. Carbon dioxide was then removed by aqueous caustic soda and the residual gas passed over metallic magnesium at 600° in order to remove nitrogen and over metallic calcium at 580° to eliminate the remaining impurities. Several hundredweights of sand were thus treated and returned to Messrs. Thorium, Ltd., who found that they could still employ the heated material in their process providing that it was mixed with a certain proportion of raw sand. The purified gas containing 99.5 per cent. of helium was compressed into storage cylinders.

CORROSION RESEARCH.

The researches on corrosion were originally started by a committee of the Institute of Metals in 1916, and after eight years the more scientific developments of these problems were undertaken by the Corrosion Research Committee of the Department of

Scientific and Industrial Research, this work being pursued in the Metallurgical Department of the Royal Schol of Mines until the workers concerned were transferred to Teddington at Easter, 1928.

Corrosion of Immersed Metals.

Research on the corrosion of immersed metals has been concentrated on an attempt to put the theory of this phenomenon on a secure quantitative foundation. For although earlier work in this country and in the United States had furnished a qualitative explanation of corrosive action in water or in salt solutions, yet this description of the process postulated the influence of more than a dozen factors on the corrosive rates of immersed metals. Accordingly, one aim of the present research is to acquire precise information as to the interaction of these factors, and another objective is to ascertain whether the lack of reproducibility in corrosion experiments is inherent in the corrosion process itself or whether it is due to imperfect regulation of all variables. Among these factors are purity of materials: metal, water, salt and atmosphere, constancy of temperature and pressure, and freedom from mechanical agitation. Zinc. of a purity of 99.99 per cent., distilled water with an electrical conductivity of 0.058 gemmhos at 20° and purified oxygen were employed, and all experiments were carried out at 25° within a temperature range of $\pm 0.02°$ over long periods of time, sometimes for upwards of six months.

Measurements of oxygen absorbed, corrected for any hydrogen evolved, made at frequent intervals during the course of such experiments have enabled one to plot continuous corrosion time curves which are often sufficiently smooth and regular to be investigated mathematically.

The apparatus employed for this purpose is shown among the exhibits from the laboratory. Originally designed for zinc it is now being used extensively for work on iron and steel.

Oxygen passes through water or salt solutions to the immersed metal either by diffusion or convection, but the latter mode of transference is by far the more effective at more than very shallow depths. Convection currents may arise in a salt solution owing to four different causes: (1) temperature changes, (2) density changes produced by evaporation at the surface layer, (3) density changes produced by differences of oxygen concentration, (4) mechanical agitation. The apparatus employed for these quantitative experiments is immersed in a thermostat and corrosion occurs in a closed space within it so that the effects of temperature changes (1) and evaporation (2) are practically negligible, and special precautions are taken to prevent agitation (4). Accordingly, by removing oxygen from the neighbourhood of the metal, the corrosion process produces convection currents of the third category due to changes in concentration of oxygen. The velocity of these convection currents depends on the difference in density between the solution saturated with oxygen at the liquid surface and the solution next to the metal. Assuming that the latter solution contains very little oxygen, the velocity of convection will probably be proportional to the solubility of oxygen in the liquid, but the amount of oxygen carried by the current is also proportional to its solubility. Hence, the rate of corrosion (y) should be proportional to the square of the oxygen solubility (x), a relation which is expressible by the equation $y = kx^2$. This assumption has been verified for on plotting the observed rates of corrosion against oxygen solubility one obtains curves of parabolic form.

Hydrogen evolution due to the interaction of water or salt solution with metals such as zinc or steel is of greater importance than is generally supposed. Determinations of the hydrogen liberated during zinc corrosion have shown that a very small amount of impurity has a considerable influence on the amount of gas evolved. In N/10,000 potassium chloride measurable quantities of hydrogen are obtained from 99.99 per cent. zinc, whereas no hydrogen was detected from zinc of spectroscopic purity. The proportion of zinc corrosion due to evolution of hydrogen increases with concentration of potassium chloride, and with 2N-solutions it amounts to 17.4 per cent. of the total corrosion.

When all the foregoing factors are taken into account, successive corrosion experiments exhibit a high degree of reproducibility and the curves indicates that duplicates differ from their mean value by 1 per cent. or even less. This constancy indicates that the corrosion of zinc and allied metals is not inherently erratic, but is quite a suitable subject for physico-chemical investigations.

(To be concluded.)

THE HISTORY OF ORE TREATMENT PROCESSES IN BROKEN HILL.*

E. T. Henderson.

*From the *Proceedings* of the Australasian Institute of Mining and Metallurgy.

(*Concluded from page* 170.)

By 1906 the separation of the sulphides of zinc from the gangue was well established in Broken Hill, and the improvements made in the next three or four years were chiefly mechanical ones. The treatment of slime, however, was still causing trouble. The Proprietary company treated a large quantity by first making it into bricks, which were then air-dried and built into kilns and fired. This got rid of a lot of the sulphur, and the sintered product was sent to Port Pirie and smelted with the lead concentrate. In this way the lead and silver contained was largely recovered, but the zinc was lost in the slag. This sintering operation was conducted about four miles out of Broken Hill, and close to the railway line.

The Sulphide Corporation erected a flotation plant to treat its slime, and produced a mixed lead-zinc concentrate. This product, at that time, was not in demand by either the lead or the zinc smelter. The value of the metals contained in this class of concentrate was high, but the returning charge was also high, and on realisation very little was left to pay for the cost of treatment.

A lot of experimental work was done in trying to separate the galena from the blende in these mixed concentrates and in the original slime. In 1910 Mr. E. J. Horwood first solved this problem, and obtained a patent for his method of doing it.

He took advantage of the fact that galena oxidised much more readily than blende, and by oxidising the galena and then submitting the product to flotation only the blende floated and the lead was left as a residue with any gangue which was present.

This oxidation of the galena was brought about by heating the mixed lead-zinc concentrate to a temperature of between 400° and 500° C. in the presence of air. The galena became coated with a layer of lead sulphate, which rendered it unfloatable, while the blende was not affected at this temperature.

This process was developed and put on a commercial basis by the Zinc Corporation, which worked it for some time. The cost of the treatment was high, due to the numerous operations required.

Wet methods were tried to bring about the same result, viz., the oxidation of the galena, but with very indifferent results.

In 1912 Mr. F. J. Lyster succeeded in preferentially floating the galena from the blende, and to him, and the Zinc Corporation who developed his process, is due the honour of being the first to do this commercially.

A few months later in 1912 Mr. Leslie Bradford discovered another way of separating these two sulphides. He found that by using a solution of common salt, feebly acidulated with sulphuric acid, the zinc only would float, leaving the lead in the residue. By applying this method to mixed sulphide concentrates a high-grade zinc concentrate was floated and a residue high in lead remained.

In 1913 Mr. T. M. Owen also succeeded in floating the galena preferentially to the blende and obtained a patent.

Both Mr. Lyster's and Mr. Owen's processes gave the same results, that is, the lead floated first and the zinc afterwards. Mr. Lyster relied on certain salts being present in the flotation circuit liquor to account for the result obtained, while Mr. Owen relied on controlling the air supply.

In the writer's opinion both Mr. Lyster and Mr. Owen discovered the same thing, viz., that clean untarnished galena floats much more readily than blende, and that by modifying the conditions used for producing a mixed concentrate they first obtained a lead concentrate and then a zinc concentrate.

It is easy to criticise these patents in the light of our present knowledge, but it is certain that if either of these two gentlemen had known then what was actually the cause of the result they obtained, their patents would have been worded differently and would have been much more valuable.

Owen was the first to use sub-aeration and Lyster the first to successfully float galena in preference to blende. The Lyster process was satisfactory only when the galena faces were untarnished, and dump material, oxidised to any extent, gave poor results, as the galena was reduced by oxidation to a degree of floatability equal to or less than that of the blende. Further, with calcite gangue

the process was successful, but with rhodonite gangue results were bad, as the mine water was heavily charged with iron salts which oxidised the galena particles with a very depressing effect.

The Proprietary ore, having a rhodonitic gangue, was not amenable to treatment by Lyster's process.

At this date, 1912, there appeared to be only two processes by which the Proprietary slime could be treated. One was the Horwood process and the other the Bradford salt sulphuric process. As both of these worked best on a mixed concentrate, experiments were conducted to find a way of producing this cheaply.

These experiments led Mr. Bradford to discover that, by using a solution containing sodium sulphate, a good separation of the sulphides from the gangue could be obtained without the addition of oil.

This idea was patented by him in 1913, and was the first patent for a mineral frothing agent.

A plant was erected to produce mixed concentrates by this method. It consisted of an agitator in the form of a centrifugal pump which delivered into cone-shaped separation boxes, in which the froth of sulphides overflowed the top, and the gangue and solution were drawn to the next agitator from the bottom. This type of plant had been in experimental use on the mine for some time.

These experiments also led Mr. Bradford to the discovery that small additions of a soluble copper salt greatly increased the floatability of sulphides, and this was patented in Australia.

Later in the same year (1913) Mr. Bradford discovered that certain salts which liberated SO_2 had a tendency to prevent the zinc from floating, and by using additions of these salts in acid solutions or by using air containing SO_2 he was able to float the lead in preference to the zinc from the Proprietary slime. After removing the lead he succeeded in floating the zinc by heating the solution or by adding copper sulphate or by both of these modifications.

Experimental work on this method was conducted in the plant erected to produce mixed concentrates, and the results were so encouraging that the company decided to increase the size of this plant to enable it to treat the large tonnage of slime contained in the dams, as well as the current output from the mill.

This plant was started in September, 1916, and treated about 4000 tons of slime a week. The profit from this treatment was very great and, fortunately, came at the time when the company was building its steel works at Newcastle.

The work performed in this plant was so good that, when the slime dumps were all put through, the company decided to do away with the vanner section of the gravity plant and to send the sands as well as the slime to the flotation plant, only retaining the crushing machinery and the jigs in the gravity section. This called for slightly finer crushing than when vanners were used, but the recovery of lead, silver, and zinc was increased.

This method of treatment was started in November, 1923, and was very successful, being used until the mine closed down. A great deal of experimental work has been carried out in Broken Hill on various forms of agitation apparatus to bring about flotation, and machines have been evolved which have very materially added to the success of flotation separation.

Great credit is due to Messrs. Seale and Shellshear for their inventions, which include the Cascade process, a novel form of agitator, in which agitation and aeration are brought about by the pulp itself in falling from a higher to a lower level. For a time it appeared as if this apparatus would replace all others. It did excellent work on several plants. Their horizontal shaft apparatus is also in favour on some of the plants to-day and gives good results.

It is beyond the scope of this paper to deal with every detail of the treatment processes. Those only have been mentioned which, in the writer's opinion, are the milestones along the road which has led to the successful development of the treatment processes.

Those who have been actively engaged in bringing flotation to its present high state of perfection in Broken Hill, have, the writer believes, just cause to be proud of their achievement, for they have reared commercial flotation from its infancy, and have set a standard which the rest of the world has been quick to recognise and to follow.

PRESENT STATUS OF THE JAPANESE RAYON INDUSTRY.

By Hazime Okada.

During the last few years, stimulated by the world-wide development of the rayon industry, Japan has made also a remarkable progress in it. She can be reckoned now among the six great rayon producing countries, last year's production of Japan being next to that of France and greater than those of Belgium and Holland. The reasons why such an expansion has come about are attributed partly to the rise of the general interest of the world in the new industry and partly to the rapid increase of the domestic demands for rayon goods in Japan. The ever-increased demands for artificial silk have urged the erection of new companies and the expansion of existing ones, and the production thus rapidly increased has been easily consumed in turn by the interior demands, and has suppressed gradually the importation from abroad. Now the greater part of the rayon yarn imported is re-exported as finished rayon goods. The interior demands for rayon goods will still increase for some time to come, for the peoples of Japan have only just began to appreciate the rayon fabrics appropriately and the applications of the rayon yarns in the Japanese textiles are ncreasing to various directions.

But now it is generally accepted that the vigorous strides with which the Japanese rayon industry hitherto advanced, came to an interruption, and that the future development will depend rather upon the extension in the foreign trade than upon the domestic consumption. Though the export of the rayon yarn is now yet insignificant even to the oriental markets, that of rayon fabrics is developing most promisingly and upon this much hope is put.

The total capital of the nine companies now in operation is estimated as about Y90,000,000, of which Y60,000,000 is paid, and the last year's production amounted to 27,000,000 lbs. of rayon yarn. All these companies work on the viscose process, but a Bemberg process plant is expected to be started shortly by one of the air-nitrogen manufacturers. The acetate process will not be commenced yet in Japan.

In its quality the Japanese rayon yarn is not inferior to the standard products of the advanced European and American companies, multi-filamented or fine-filamented yarns being now produced.

Consumption of the rayon yarns by the textile manufacturers is fairly balanced with the production in our country, and the imported yarns are now of minor importance in this respect. Italy and Germany are the predominating countries, whence the rayon yarns are imported, the former supplies rather the lower grade yarns and the latter the higher. Rayon woven articles (including mixed woven textiles) thus produced were estimated to he Y90,000,000 in 1929, 30 per cent. of which was imported mainly to the oriental markets, and 70 per cent. was consumed in our country. Thus, the rayon industry, which had been once either neglected as insignificant or regarded with hostility as a rival of the Japanese natural silk industry, is now met with a general welcome, for it may possibly play an important rôle in respect of the improvement of the Japanese foreign trade in the future. So far as the superiority of the situation of the Japanese rayon fabrics, now steadily established in the oriental markets, and the possibility of a still further increase of demands in these markets are concerned we are now in a good condition.

Of the rayon raw materials, the caustic soda and the pulp are now imported. The production of caustic soda in the country is restricted partly by the limited demands for the electrolytic chlorine and partly by the unfavourable conditions of the soda-ash industry. Rayon pulp, now exclusively imported, will be replaced in the near future by the domestic pulp, now that the Japanese pulp is gradually recognised to be capable of being adopted as rayon materials. Pulp makers of Japan, who had formerly neglected the rayon industry as its pulp-consuming capacity had been insignificant compared with that of the paper industry, came to take this into consideration, being affected by the ability of the new industry now realised.

Production, Importation and Exportation of Rayon Yarns.

(Unit 1000 lbs.)

	Production	Importation	Exportation
1918 ...	100 ...	77 ...	7
1919 ...	140 ...	75 ...	30
1920 ...	200 ...	80 ...	15
1921 ...	250 ...	138 ...	5
1922 ...	527 ...	226 ...	6
1923 ...	780 ...	952 ...	5
1924 ...	1,368 ...	810 ...	5
1925 ...	3,200 ...	833 ...	10
1926 ...	5,000 ...	3,317 ...	20
1927 ...	10,500 ...	800 ...	70
1928 ...	16,500 ...	257 ...	224
1929 ...	27,000 ...	624 ...	463

Of these figures, the exportation comprises the domestic yarn exported as such and those parts of imported yarns that are woven in the rayon fabrics exported. In 1928, 68,000 lbs. of Japanese yarn as such and 156,000 lbs. of imported yarns as rayon fabrics were exported, and in 1929, 155,000 lbs. and 308,000 lbs. of each exported.

U.S. CHEMICAL PRODUCTION GAINS 278 PER CENT. IN FOURTEEN YEARS.

A survey of the chemical industry in the U.S.A. shows that between 1913 and 1927 it gained in production 278 per cent., against a world increase of 220 per cent., according to the New York Trust Company.

Output in the United States in 1913 amounted in value to $816,000,000, or 34 per cent of world production. In 1927 this had increased to $2,268,000,000, or 43 per cent.of the world total for that year. Germany, the next largest producer, was responsible for 24 per cent of the world total in 1913, but for only 16 per cent in 1927, the surveys brings out.

Similarly, Great Britain's share fell from 11 per cent. in 1913 to 9.5 per cent. in 1927 and that of France from 8.5 per cent. to 6.8 per cent. In 1913 Germany and Great Britain together produced more chemicals than the United States, but by 1927 she had far out-distanced them and accounted for the equivalent of the production of the eight leading Europeaf countries combined."

ABSORPTION AND COLLISION BROADENING OF THE MERCURY RESONANCE LINE.

By M. W. Zemansky.

Palmer Physical Laboratory, Princetown, N. J.

Radiation emitted by a mercury resonance lamp.—It is shown how an approximate expression for the frequency distribution of the radiation from a resonance lamp can be arrived at, and that it can be represented approximately by a Gauss error curve with a half-breadth depending upon the geometry of the lamp and upon the vapour density, and in general greater than that of the absorption line.

Absorption coefficient and ratio of emission to absorption line breadth.—Assuming that all five components of the mercury resonance line are alike both in emission and in absorption, and that any one component of the emission and of the absorption line is a Gauss error curve of half-breadth $\Delta\nu_E$ and $\Delta\nu_D$ respectively ($\Delta\nu_D$ = Doppler breadth), the absorption of a slab of thickness l is calculated as a function of $\kappa(\nu_0)l$, where $\kappa(\nu_0)$ is the absorption coefficient for the centre of any one of the components. From experimental values of the absorption, $\kappa(\nu_0)$ is found to be consistent with the theoretical value $1.41 \times 10^{-13}N$ (where N is the number of Hg atoms per cc) provided $\Delta\nu_E/\Delta\nu_D$ is taken to be 1.21 in these experiments, 1.46 in Orthmann's, 1.50 in Hughes and Thomas', 1.15 in Kunze's and 1.15 in Kopfermann and Tietze's.

Lorentz collision broadening of the absorption line.—A theoretical expression is obtained for the absorption coefficient when collision broadening is superimposed upon Doppelr broadening, and is evaluated for different values of the frequency and of $\Delta\nu_C/\Delta\nu_D$ where $\Delta\nu_C$ is the Lorentz collision breadth and $\Delta\nu_D$ is the Doppler breadth. With $\kappa(\nu_0)l$ and $\Delta\nu_E/\Delta\nu_D$ equal to the values found for these experiments, the absorption is calculated as a function of $\Delta\nu_C/\Delta\nu_D$. The curves of $\Delta\nu_C$ against pressure yield the effective broadening radius of each molecule, which is found to be directly proportional to the square root of the molecular diamagnetic susceptibility. On the basis of the Langevin theory this means that the effective broadening area of a molecnle varies at the product of the number of outer elecrons and the mean square radius of all the electronic orbits. The same result is obtained from the experiments of Füchtbauer, Joos and Dinkelacker.—*Physical Review.*

GENERAL NOTES

VALUABLE SERVICE RENDERED BY THE CANADIAN GEOLOGICAL SURVEY.

An example of the desirability of obtaining reliable advice before commencing a mining development scheme was furnished recently by the Geological Survey Branch of the Dominion Department of Mines, Ottawa. Residents of the north Okanagan valley in British Columbia were led to believe for a considerable time that there was a possibility of locating oil in that district. This interest was accentuated owing to the further discovery of oil in Alberta.

During the course of field work this year one of the geologists of the Geological Survey undertook an investigation in the Okanagan district and he found that there was no evidence to justify the belief that oil might be found in this region. The occurrence at different localities of dome-shaped hills or knolls, projecting above the more regular valley contours or bench levels, had been interpreted as oil or gas domes regardless of the underlying rock structure. Coaly material and carbonaceous matter, in no way related to oil, which occur in Tertiary sediments, had been referred to as "dried oil" and a strong indication of underlying reservoirs of oil. Thin scums over the surface of pools, lakes, and along other waterways, were considered an indication of oil seepage from underlying "oil formations," but on investigation it was found that these scums resulted from the decay of vegetable or animal matter, from oil wastage, or other local agencies.

The geological formations consist of: (a) rocks of igneous origin in which reservoirs of petroleum are never found, (b) sedimentary rocks that have been so squeezed and baked that any petroleum they may have contained has been expelled, (c) less altered sedimentary rocks that were deposited under such unfavourable conditions and have been subjected to such close association with volcanic rocks that they cannot be considered of significance as petroleum-bearing formations. This evidence alone was sufficient to contradict any reports that there was a possibility of striking oil in the north Okanagan valley, and although actual drilling operations had previously been undertaken the official investigation by the Geological Survey will undoubtedly prevent any wasteful expenditure on such development operations in this area in the future.

A thorough knowledge of the geology of a district is not only desirable but necessary before attempting development operations in order to avoid unwarranted expenditures. By disseminating information concerning the geology of Canada, the Geological Survey is rendering valuable service to the people of Canada and serves to retain confidence in legitimate mining undertakings.

PROFESSOR SAYS MEAT SHOULD BE WASHED PRIOR TO COOKING.

A verdict of "Death from poisoning, caused by eating contaminated mutton, with no evidence as to the cause of contamination," was recorded at the inquest at Wallasey (Cheshire) on August 27th, on the body of Mrs. Frances Cartman, aged 52, wife of a shoemaker at Holywell. Mrs. Cartman died at Wallasey Cottage Hospital after being taken ill at her sister's house in Cartmel-drive, Moreton, where she had mutton for tea. Eight other persons were also ill after eating the mutton, but recovered. Professor J. E. W. McFall, of Liverpool University, said an examination of the portion of mutton left after the meal revealed the presence of a bacillus responsible for food poisoning. The bacillus was introduced by contamination from an unknown source. The Coroner said he was informed that 60 or 70 purchasers of the remainder of the carcass of the mutton had been made, but there had been no complaints other than those mentioned at the inquest. The Coroner welcomed Professor McFall's suggestion that all meat should be washed before being cooked in the present state of the weather.

AN IMPORTANT DISCOVERY.

The recent discovery of a large souterrain or underground dwelling in a remote country district in Co. Cork, Ireland, has provided much food for thought for archæologists in a freshly discovered link with the far distant past. Although the existence of this souterrain became known locally some months ago, it was not until recently that it has had direct attention of experts focussed upon its archæological values.

Several of these souterrains exist in Ireland, but no definite information can be obtained as to when they were constructed, or for what purpose they were used, but they are commonly believed to belong to the period of Viking raids from about the year 800 to the year 1100.

Proceedings and Notices of Societies

THE INSTITUTE OF METALS.

ANNUAL GENERAL MEETING AT SOUTHAMPTON

(Continued from last week, p. 174).

The Diffusion of Aluminium into Iron. By N. W. AGEEW, Met.Eng., AND OLGA I. VHER, Min.Eng.

The action of aluminium on iron has been investigated. The process takes place in two stages : (1) Solution of iron in liquid aluminium; (2) diffusion of the alloy formed into solid iron. The structure of the region where the action occurs has been studied, at different temperatures, both for the first and the second stages. Weiss' Law of Diffusion has been verified for the binary system iron-aluminium, and the variations of the rate of diffusion with temperature and time demonstrated. The data of other investigators of the system iron-aluminium have been critically examined, and a diagram, which is considered to be most nearly correct, has been constructed after a series of check experiments.

The Artificial Ageing of Duralumin and Super-Duralumin. By K. L. MEISSNER, *Dr.-Ing.*

The effect of artificial ageing from 50° to 200°C. upon two commercial Duralumin alloys, 681B and 681B1/3, and upon super-Duralumin (Duralumin with addition of silicon) has been investigated. The periods of tempering were generally 20 and 40 hrs. The artificial ageing was applied in the first series after ageing at room temperature; in the second series immediately after quenching from high temperatures (about 500° C.). No substantial difference was observed between the two series.

In a third series, test-pieces were artificially aged after having been age-hardened at room temperature and cold-rolled. In this series, an interesting phenomenon could be observed at about 100° to 125° C. in that material was produced having high tensile strength and elongation, combined with a yield-point which was about 33 to 53 per cent. higher than obtained in the two other series investigated.

The effect of artificial ageing upon Duralumin consists, after an initial softening at lower temperatures, mainly in raising the yield-point, whilst the tensile strength is influenced only slightly. At the same time, the elongation, flexibility, and other cold-working properties are decreased very markedly, and as shown in previous work the resistance against corrosion is also decreased.

In contrast to Duralumin, the tensile strength of super-Duralumin is markedly raised by artificial ageing, but the rise keeps behind that of the yield-point, relatively. The other properties are, in general, substantially the same as those for Duralumin.

A Study of the Relation between Macro- and Microstructure in Some Non-Ferrous Alloys. By MARIE L. V. GAYLER, D.Sc.

The results of a previous investigation are confirmed—*i.e.*, the higher the temperature from which an alloy is cast the coarser becomes the microstructure, and at the same time the microstructure becomes finer, but in a less marked degree.

Variation in the ratio of the cross-section of the mould to that of the casting effects both macro- and microstructure, but provided this ratio remains constant and the casting temperature is not much above the liquidus, there is little difference in either the macro- or microstructure of alloys whether cast into steel or graphite moulds. If, however, the casting temperature is raised the macrostructure of the alloy cast into a steel mould is slightly different from that cast into a graphite mould, but the microstructures are almost identical.

The macro- and microstructure of an alloy does not seem to be affected by various gases, *provided the casting temperature is kept low.* If, however, the casting temperature is raised, the atmosphere to which the molten metal is exposed has a very marked effect on the macrostructure, together with a small effect on the microstructure. Hydrogen, under the conditions mentioned, causes the formation of a fine macrostructure in contrast to that obtained on casting under normal conditions.

It has been shown that a copper-aluminium alloy which has been previously freed from gas by the nitrogen process and then melted *in vacuo*, still shows inverse segregation; also the effect on segregation in an an alloy which has been exposed to nitrogen or hydrogen has been noted.

It appears that the presence of furnace gases has little effect on the "modification" of aluminium-silicon alloys. "Modification" of a silicon-aluminium alloy cannot be obtained by casting into a heavy water-cooled copper mould.

The Effects of Two Years' Atmospheric Exposure on the Breaking Load of Hard-Drawn Non-Ferrous Wires. By J. C. HUDSON, D.Sc., D.I.C., A.R.C.S.

Details are given of tests on a number of hard-drawn non-ferrous wires, in which de-

terminations of the breaking load were made before and after exposure to the South Kensington atmosphere for two years. Owing to the fact that appreciable changes took place in the strength of the unexposed wires, it is not possible to arrange the materials in a definite order of merit as regards resistance to atmospheric corrosion. The losses in strength after two years' exposure were, however, very small, and the observations confirm the results of earlier work in showing that under straightforward conditions the majority of non-ferrous materials are very resistant to atmospheric corrosion. Brass is an exception to this statement, as its strength is adversely affected by the copper redeposition that accompanies atmospheric corrosion. A few remarks are made on the atmospheric corrosion of copper-nickel alloys.

The Open-air Corrosion of Copper. Part II. The Mineralogical Relationships of Corrosion Products. By W. H. J. Vernon, D.Sc., Ph.D., D.I.C., and L. Whitby, M.Sc.

The composition of patina from copper structure of various ages in representative localities has been critically examined with the view to ascertaining whether definite formulæ could be ascribed to the principal constituents. Complete agreement with the formula of the corresponding mineral has been realised in products after 70 years' exposure and upwards. Basic copper sulphate (under most conditions the major constituent) then coincides in composition with brochantite, $CuSO_4.3Cu(OH)_2$; basic copper chloride (in products near the seaboard) with atacamite, $CuCl_2.3Cu(OH)_2$; basic copper carbonate (usually present but in minor proportion) with malachite, $CuCO_3.Cu(OH)_2$. After shorter periods of exposure the basicity of the product is lower than that of the corresponding mineral.

Silicon-Copper Alloys and Silicon-Manganese-Copper Alloys. By E. Voce, M.Sc., Ph.D.

The paper records a survey of silicon-copper and of silicon-manganese-copper alloys, studying their mechanical and physical properties in the cast, drawn, and rolled conditions, with a view to developing and extending their uses. Their resistance to corrosion has received attention, especially in the light of the development in America of alloys of copper with silicon and manganese in connection with chemical plant.

The paper has been divided into the following sections:

1 Introduction.
2 Constitution of the Silicon-Copper Alloys.
3 Silicon-Copper Alloys:
  (a) The Properties of Cast-Silicon-Copper Alloys.
  (b) The Mechanical and Electrical Properties of Silicon-Copper Wire containing up to 1 per cent. of Silicon.
  (c) The Production and Properties of Silicon-Copper Sheet.
4 *Silicon-Manganese-Copper Alloys:*
  (a) Introductory Remarks.
  (b) The Preparation of a Series of Alloys for Examination.
  (c) Microscopic Examination.
  (d) The Mechanical Properties of Cast-Silicon-Manganese-Copper Alloys in the Cast Condition.
  (e) The Production and Properties of Silicon-Manganese-Copper Sheet.
5 Corrosion Tests.
6 Oxidation of Silicon-Copper and Silicon-Manganese-Copper Alloys at High Temperatures.
7 Summary and Conclusions.
  Appendix: The Materials Used.
  Acknowledgments.

A New Silicon-Zinc-Copper Alloy. By Dr. E. Vaders.

The range of the α-solid solution phase at the copper end of the diagram has been determined and it is shown that the 90 per cent. copper alloy can take up 4.5 per cent. silicon into solid solution. Earlier investigators considered 2 per cent. silicon to be the maximum solid solubility in this alloy and regarded all alloys with more silicon than this as brittle and therefore useless. The present work shows, however, that alloys with 2-5 per cent. silicon and 70-90 per cent. copper have valuable properties. The best alloys within this range are those with 80-82 per cent. of copper; these can be forged hot, rolled and extruded and give good castings, in chill sand or pressure moulds. The cast alloys have a dense uniform structure free from shrinkage cavities even in the thickest parts. In the cast state, the tensile strength exceeds 50 kg./mm.^{2} with an elongation of 10-15 per cent.; after forging or drawing these figures rise to 65-85 kg./mm.^{2} and 30-10 per cent. respectively. According to the state of the

alloy, whether cast, pressed or drawn, the hardness varies from 120 to 170. The alloys are suitable for the manufacture of bearings and bells. For the latter purpose they give results equal in every way to those obtained with a good tin-bronze.

The Effect of Phosphorus on the Strength of Admiralty Gun-Metal. By H. C. DEWS.

The effect of phosphorus up to 0.131 per cent. on the tensile strength, elongation, Brinell Hardness, density, and microstructure of sand-cast Admiralty gun-metal has been investigated. Particular attention has been paid to the effect of casting temperature on the alloys. It is shown in the paper that phosphorus up to approximately 0.05 per cent. has little effect on the mechanical properties or structure of Admiralty gun-metal. Above 0.05 per cent. phosphorus causes the appearance of free Cu_3P and at the same time a reduction in the mechanical properties.

A Note on the Constitution of the Cadmium-Zinc Alloys. By D. STOCKDALE, M.A., Ph.D.

Recent work on the constitution of these alloys has indicated that Jenkins has underestimated the mutual solubilities of the two metals. The author finds that zinc is somewhat more soluble in cadmium than Jenkins has shown, but there is exact agreement about the constitution of the zinc-rich alloys. The discovery that certain of the alloys partially liquefy on a falling temperature has been confirmed.

" Pendulum " Hardness Tests of Commercially Pure Metals. By D. A. N. SANDIFER, M.Sc.

Investigation limited to metallic elements. Description of 24 metals tested. Description of the hardness tester. Conversion to Brinell hardness numbers. Methods of preparation and testing. Definition of time work-hardening capacity. Relation between time hardnesses for different pendulum lengths. Relation between scale hardness and scale work-hardening capacity. Relations between time hardness, Young's modulus, and relative atomic volume. Effects of rolling. Effects of impurities.

Heat - treatment, Ball - Hardness, and Allotropy of Lead. By F. HARGREAVES, A.R.S.M., D.I.C.

From quenching and ball-hardness tests on lead of high purity, it is suggested that lead is allotropic, the suggested critical points being 187°C. and 228°C. approximately. The hardness varies greatly with the heat-treatment.

Very marked changes take place in the hardness immediately after quenching.

The presence of 0.005 per cent. tin inhibits these marked changes and they do not take place in commercially pure lead.

Each sample tested shows increased hardness resulting from quenching.

NOTICES OF BOOKS.

Chemistry of Familiar Things. By SAMUEL SCHMUCKER SADTLER, S.B. Pp. xii + 342. London: J. B. Lippincott Company, 16, John Street, Adelphi, W.C.2.

The scientific world of to-day has made such rapid progress during recent years in all branches of science, and the demand for an insight into chemistry by those whose reading or training has been directed in other channels, has become so great, that the author was prompted to write this book which to the ordinary intelligent person should prove helpful in learning more about Nature and the conditions under which we live.

The writer has dealt principally with the chemistry of such subjects as Air, Water, Metals, Rocks, Soil, Food, Textiles, Chemical Evolution and Physiological Chemistry, and has only introduced sufficient elementary chemistry in the first chapter to enable the reader to better understand and appreciate the sequel.

This book should also prove very useful to those who are interested in scientific matters, and those who desire an exposition of everyday practical chemistry. It differs greatly from the ordinary chemistry text-book and if studied carefully should produce very tangible results.

A NEW PUBLICATION.

ORGANIC SULPHUR COMPOUNDS UNDER GAS-MAKING CONDITIONS.

The Johns Hopkins University, Baltimore Md., announces the publication August 1, 1930, of the dissertation by J. C. Holtz, entitled " The Origin and Decomposition of Organic Sulfur Compounds under Gas-Making Conditions with Particular Reference to the Role of the Carbon Sulfur Complex." This is an original investigation of importance to the gas industry, and because of its value has been made available at a non-profit price of one dollar, which covers merely the cost of printing and distribution. This dissertation consists of ten chapters, the first five being historical, and the last experimental with bibliography, thermodynamical calculations, and a summary of findings as a result of this research.

Forthcoming Events.

ROYAL AGRICULTURAL SOCIETY OF ENGLAND.

The 90th Annual Show will be held at Warwick from Tuesday, July 7, to Saturday, July 11, 1931.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

25,401.—Becher, W. — Preparation of chlorine dioxide. August 26.

25,816.—I. G. Farbenindustrie Akt.-Ges. Manufacture of aminosulphonic acid. August 29.

25,864.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of derivatives of 2 : 3-hydroxynaphthoic acid. Aug. 29.

25,369.—Imperial Chemical Industries, Ltd., and Thompson, R. F.—Production of anthracene derivatives. August 25.

25,440.—Imperial Chemical Industries, Ltd. — Manufacture of halogenonitrobenzenes. August 26.

Specifications Published.

312,345.—Du Pont de Nemours & Co., E. I. —Catalytic dehydrogenation.

333,946.—Carpmael, A. (I. G. Farbenindustrie Akt.-Ges.)—Process for the manufacture of chlorine and bromine derivatives of compounds of the acetylene series.

333,991.—Groves, W. W. (Badger & Sons, Co., E. B.)—Manufacture of acetic anhydride.

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BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

SECTION B.—CHEMISTRY

A STATE EXPERIMENT IN CHEMICAL RESEARCH.

By PROF. G. T. MORGAN, O.B.E., D.Sc., F.R.S., *President of the Section.*

(*Concluded from page 183.*)

ATMOSPHERIC CORROSION.

Investigations of various types of indoor and open-air corrosion and of protective oxide films, previously conducted under the auspices of the Atmospheric Corrosion Research Committee of the British Non-ferrous Metals Research Association, were taken over by the Department of Scientific and Industrial Research in July, 1927. This work was continued at the Royal School of Mines until 1928, when the corrosion section was transferred to the Chemical Research Laboratory. The more outstanding results since obtained are as follows:—

Composition of Green Patina on Copper Structures.—Samples of the familiar green patina on exposed copper surfaces, obtained from typical localities, town, country, marine and urban-marine, were analysed completely. Contrary to the general belief, basic copper carbonate was found to be not the principal but only a minor constituent of the green patina. With the exception of the product from a purely marine atmosphere in which basic copper chloride predominated, the major constituent throughout was basic copper sulphate, and excess of basic sulphate over basic carbonate was greater in the rural than in the urban samples. Where urban and marine conditions coincided, basic sulphate predominated greatly over both basic chloride and basic carbonate.

It has recently been found that these constituents of the green patina tend to assume the chemical composition of the corresponding green copper minerals. In the limits, the basic copper sulphate of corrosion coincides in composition with brochantite of which the co-ordination formula is $[Cu\{(HO)_2Cu\}_3]SO_4$, and the basic copper chloride of corrosion with atacamite $[Cu\{(HO)_2 Cu\}_3] Cl_2$. Basic copper carbonate, on the other hand, tends to assume the composition of malachite $[Cu\{(HO)_2 Cu\}] CO_3$. Complete agreement with the composition required by the co-ordination theory has been realised in corrosion products after 70 years' exposure and upwards. After shorter periods of exposure the basicity of the product is in a lower ratio than that of the corresponding minerals.

The complete analysis of these corrosion products entailed special precautions. The carbonates were decomposed by phosphoric acid instead of hydrochloric or sulphuric acid, and any hydrogen chloride and hydrogen sulphide simultaneously set free were elminated by *p*-nitrosodimethylaniline and copper powder respectively.

Corrosion of Magnesium Alloys. — The growing use of light magnesium alloys for motor-car and aircraft work has necessitated increased attention to the corrosive properties of these metals. In 1929 a research was begun with the object of discovering improved methods of protection and of learning more about the nature of the corrosion. More than 500 different protective coatings have been produced by chemical means and tested for resistance to sea-water sprays. Of these coatings a few are sufficiently promising to warrant further study.

CHEMOTHERAPY.

In 1927 a joint Exploratory Committee of the Department of Scientific and Industrial Research and of the Medical Research Council decided that there was need for organised research in Chemotherapy, and accordingly the Medical Research Council set up a permanent Committee to advise them on investigations in this field. To this Committee the Department has nominated three chemical members including the Director of Chemical Research, and facilities have been afforded by the Department for a staff of three chemists to work on problems based on an agreed programme. These chemists have already prepared a considerable number of organic compounds of possible utility in chemotherapy and these are being tested systematically under arrangements made by the permanent Committee. This work of national importance is a joint effort of several groups of chemists working in different laboratories, so that in a wide and thorough search for greatly needed drugs and therapeutic agents is in progress.

The Teddington contribution to these researches may be classified under the two following main headings :—

1. *Analogues of Bayer 205 or Fourneau 309.*—Last year in his Presidential Address to the Physiology Section of the British Association in South Africa, Prof. W. E. Dixon referred to the serious ravages produced in that continent by sleeping sickness (trypanosomiasis), and his admirable survey of the position from the view point of chemotherapy renders unnecessary any further elaboration of that aspect of the problem in the present summary.

The activity of medicaments of the Bayer 205 or Fourneau 309 type may depend more on the aggregate effect of the whole molecule rather than on the presence in the molecule of any particular group or arrangment. In this, as in other cases, there are no definite laws connecting therapeutic activity and chemical structure.

Compounds have been prepared in which the terminal aminonaphthalenedisulphonic radicals have been replaced by analogous complexes derived from aminocarbazole di- and tri-sulphonic acids or from the disulphonic acids of aminofluorene and of aminofluorenone, but so far the effect of this substitution has not been encouraging. The possibility of a beneficial introduction of arsenic into the fluorene nucleus has, however, been considered, and experiment has shown that trypanocidal activity is manifested when an arsinic acid radical is present in a fluorene molecule in conjunction with an amino-group.

2. *Organic Derivatives of Arsenic and Antimony.*—During many years organic arsenicals have received much attention, whereas organic antimonials have not been subjected to the same careful scrutiny, partly owing to the fact that they are more difficult to prepare in a state of purity and partly because the curative results have been less promising.

Nevertheless, since antimony in organic combination appears to possess specific trypanocidal activity and some curative action in kala-azar, experiments have been made in the Teddington laboratory on the preparation of antimony analogues of the more successfull arsenicals. Tryparsamide (phenylglycine-amido-*p*-arsinic acid) is used extensively in treating trypanosomiasis, and its antimony analogue has been under examination. In the more stable meta series, phenylglycine-amido-*m*-stibnic acid and certain allied compounds show a slight trypanocidal effect. The antimony analogue of stovarsol (3-acetylamino-4-hydroxyphenyl arsinic acid) or more probably its internal dehydration product has also exhibited some therapeutic activity.

Concurrently with this study of organic antimonials further experiments have been made on organic arsenicals produced by condensing atoxyl successively with succinic anhydride, and with a base such as am-

monia, methylamine, dimethylamine, piperidine, or aniline. Certain of these derivatives have also exhibited a definite action on trypanosomes.

In addition to the preparation of antimonials directly applicable to therapeutic tests, our knowledge of the organic chemistry of antimony has been extended among aliphatic derivatives by the production of antimony analogues of the cacodyl group and in the aromatic series by the synthesis of cyclic antimonials analogous to the alkyl- and aryl-carbazoles.

Water Pollution Research.

This research originated from a joint request made to the Department of Scientific and Industrial Research by the Ministry of Health and the Ministry of Agriculture and Fisheries.

During the past two years, experiments have been in progress under the auspices of the Water Pollution Research Board on the base-exchange method of water softening. One of the objects of this work has been to determine the most satisfactory way of carrying out the process, such points having been examined as the effect of varying the rate of flow of water through the bed of base-exchange material and the quantity, concentration and time of contact of the salt solution used in regenerating this material. There are two types of base-exchange material in actual industrial use, treated minerals and synthetic products prepared by interaction of solutions of sodium aluminate and sodium silicate. It appears from the result of the Teddington experiments that with treated minerals the exchange of bases is confined to the outer surface of the particles whereas with the synthetic materials diffusion to the inner surfaces or into the mass of the gel is an important factor. This study of the base-exchange process has also been extended to the case of waters rich in magnesium.

Disintegration of the base-exchange materials and contamination of the softened waters by silica and alumina have been investigated. At the rate of flow employed normally in water softening, the silica content of the water is not increased seriously and is certainly not greater than that often encountered in untreated waters.

In addition to this practical work a report summarising existing knowledge of the base-exchange or zeolite process for water softening has been compiled and published.

General Research.

Investigation of complex aromatic hydrocarbons.—In 1926 the Dyestuffs Industry Development Committee of the Board of Trade suggested that further fundamental research was desirable on the following coal tar products: acenaphthene, carbozole, fluorene, perylene and phenanthrene. Two of these suggestions were adopted and, with the assistance of two chemists, the Director, who is also a member of this Statutory Committee, undertook a study of acenaphthene and perylene, the work being continued until 1928. During this period considerable progress was made with the former hydrocarbon, the nitration of which was studied under anhydrous and hydrous conditions. For nitrations, in the absence of water, diacetylorthonitric acid and benzoyl nitrate were employed, the latter being a reagent discovered originally in 1906 by Prof. Francis of this university. Several new nitro derivatives were identified, and 2-aminoacenaphthene and 2-acenaphthenol (2-hydroxyacenaphthene) were prepared for the first time.

Higher Fatty Acids.—In order to identify the waxes isolated from low temperature tar a parallel research was made on the synthesis of individual waxes from the higher fatty acids. Those waxes containing an even number of carbon atoms were produced electrolytically by Kolbe's classical synthesis (1849), whereas their homologues containing odd numbers of carbon atoms were prepared by a more modern process due to Grün, Ulbrich and Krczil (1926). By these complementary processes individual waxes containing 27, 30 and 34 carbon atoms were prepared for comparative purposes. This inquiry necessitated the study of several higher fatty acids, including arachidic acid, and in such cases analytical data were confirmed by X-ray analyses carried out in the National Physical Laboratory.

Cyclic systems containing Selenium and Tellurium.—Considerable progress has been made in the study of heterocyclic systems containing selenium or tellurium atoms. The selenium series has been prepared by a general method, the interaction of alkylene bromides and sodium selenide in an inert atmosphere.

$$[CH_2]_n<\begin{matrix}CH_2\cdot Br\\ CH_2\cdot Br\end{matrix} + Na_2Se = [CH_2]_n<\begin{matrix}CH_2\\ CH_2\end{matrix}>Se + 2NaBr$$

$$n = 1,\ 2,\ 3 \text{ or } 4.$$

In this way the cyclic selenohydrocarbons with $n = 1, 2, 3$ or 4 have been obtained for the first time. The five-membered ring, *cyclo*selenobutane (tetrahydroselenophen) and its next homologue, *cyclo*selenopentane, are formed by the foregoing reaction with considerable facility, but the four- and seven-membered rings show signs of instability, and in their production comple› solid polymerides make their appearance.

In the tellurium series the correspondin; cyclic derivatives are conveniently preparec by the action of aluminium telluride oı alkylene halides. This process leads to th› production of cyclic systems containin; quadrivalent tellurium.

$$[CH_2]_n<\begin{matrix}CH_2\\ CH_2\end{matrix}>Te<\begin{matrix}CH_2\cdot[CH_2]_nCH_2\\ I \qquad\qquad\quad I\end{matrix}>Te<\begin{matrix}CH_2\\ CH_2\end{matrix}>[CH_2]_n \longrightarrow$$

$$[CH_2]_n<\begin{matrix}CH_2\\ CH_2\end{matrix}>Te<\begin{matrix}CH_2\cdot[CH_2]_n\cdot CH_2I\\ I\end{matrix} \longrightarrow [CH_2]_n<\begin{matrix}CH_2\\ CH_2\end{matrix}>Te$$

$$n = 1,\ 2 \text{ or } 3.$$

From the foregoing complex telluronium iodides the cyclic tellurohydrocarbon is obtained by thermal dissociation under reduced pressure. By such means *cyclo*telluro-butane and *cyclo*tellnropentane have been isolated and some evidence was obtained of the existence of a four-membered ring.

Aromatic Selenium and Tellurium Compounds.—Phenol and the cresols have been condensed with selenium oxychloride when two types of seleniferous products have been distinguished, polar salt-like substances (Formnla I) and non-polar selenides (Formula II).

I $[(HO.C_6H_4)_3Se]Cl$ $Se(C_7H_6.OH)_2$ II

When the cresols are condensed with basic tellurium chloride the following types were distinguished, all containing quadrivalent tellurium: $HO.C_7H_6.TeCl_3$, $(HOC_7H_6)_2TeCl_2$, $(HOC_7H_6)_3TeCl$. The more soluble of such selenium and tellurium compounds have been tested on trypanosomes, but so far no evidence of activity has been discerned.

Studies in the Diphenyl Series.—The *o*-xenylamine required in the synthesis of cyclic antimonials was formerly obtained in a somewhat tedious manner by the pyrolysis of diazoaminobenzene. This base has now been prepared by a method practicable on a large scale from commercially obtainable diphenyl.

o-Xenylamine and its homologues, fo example, 4′ : 5-dimethyl-*o*-xenylamine, ar convenient starting-points for the synthesi of carbazole and phenanthridine derivatives

RESIDUAL AFFINITY AND CO-ORDINATION.

An experimental study of the effect o various co-ordinated addenda on the valen cies, of copper, silver and gold has been pur sued during the past five years with th following results.

Stabilisation of the cupric condition.—I the absence of suitable addenda the cupri ion is unstable when in combination wit less electronegative anions such as iodide sulphite, thiosulphate, thiocyanate, selenc cyanate and hypophosphite, but by cc ordinating this metallic ion with ethylene diamine (en$=NH_2.[CH_2]_2.NH_2$) stability i thereby conferred on the bivalent condition and well-defined complex salts of the fo lowing types are obtained: $[Cu, 2en, 2H_2O]I_2$, $[Cu, 2en, R.OH]I_2(R=CH_3$ c $C_2H_5)$, $[Cu, 2en]X$ where $X=SO_3$, S_2O, S_2O_6, S_3O_6 or S_4O_6 and $[Cu, 2en]Y_2$ whei $Y=CNS$, CNSe or H_2PO_2. Moreover, th following stable normal salts $[Cu, 2en]CO_3$, $2H_2O$, and $[Cu, 2en](NO_2)_2$ are obtainabl with carbonate and nitrite radicals respe tively.

Stabilisation of the cuprous condition.—Even more noteworthy than the precedin

effect of ethylenediamine is the influence of addenda containing sulphur on the stability of the cuprous ion. Cuprous sulphate, an endorthermic compound, decomposes in water with generation of heat and loss of half its copper. $Cu_2SO_4+5Aq=CuSO_4, 5Aq+Cu$, but by co-ordinating the cuprous ion with ethylenethiocarbamide,

$$etu = \begin{matrix} CH_2.NH \\ | \\ CH_2.NH \end{matrix} > CS$$

the univalent condition becomes stabilised even in combination with nitrate, sulphate and acetate radicals. The following colourless water-soluble salts have been identified: $[Cu, 4\ etu]\ NO_3$, $[Cu, 3\ etu]_2\ SO_4$ and $[Cu, 3\ etu]\ CH_3CO_2$.

Co-ordination compounds of silver.—Since the silver ion is generally univalent, its co-ordination with ethylenethiocarbamide or other sulphur containing addenda does not involve any change of valency. It is, however, significant that [Ag, 3 etu] Cl is a water-soluble salt which remains colourless even after prolonged exposure to light.

A contribution to the chemistry of bivalent silver has been made by co-ordinating its ion with a-a'-dipyridyl (dipy), and the following coloured salts have been isolated $[Ag, 2\ dipy]\ S_2O_8$ (chocolate brown), $[Ag, 2\ dipy]\ (HSO_4)_2$ (dark brown plates) and $[Ag. 3\ dipy]\ (ClO_3)_2$ crystallising in well defined, lustrous, black, acicular prisms.

Stabilisation of the aurous condition.—Co-ordination of gold salts with ethylenethiocarbamide has the same effect as with copper compounds. The fundamental univalency of the metallic ion becomes stabilised so that the following complex salts have been identified: $[Au, 2\ etu]_2SO_4,\ 2H_2O$, $[Au, 2\ etu]\ NO_3$, $[Au, 2\ etu]Cl, H_2O$ and $[Au, 2\ etu]Br, H_2O$. These compounds are colourless and dissolve in water to practically neutral solutions (P_H value about 6.2). Conductivity experiments indicate that in dilute aqueous solutions these complex salts are highly ionised so that the complex radical $[Au, 2\ etu]^1$ plays the part of a compound alkali ion. The bromide of this series was mentioned last year by Prof. W. E. Dixon (*loc. cit.*) as being a compound which had the effect of delaying death when administered to animals infected with bovine tuberculosis.

CHEMICAL ENGINEERING.

The mainstay of the foregoing investigations are the well-equipped workshops manned by five skilled artisans who are engaged on the production and maintenance of the appliances and plant required in the various research programmes. Appliances for high-pressure chemistry are a speciality of the laboratory workshops, and such plant includes bombs and pre-heaters for flow-through experiments with gaseous reagents, and autoclaves of various types for reactions with gases, liquids, and solids. The researches on tar products call for automatic extractors, filter plant and still operating under either ordinary or diminished pressures.

THE STATE LABORATORY AND THE SCIENTIFIC PUBLIC.

The twofold primary aim of any State research laboratory should be the collection and dispersal of scientific knowledge and information. For the former function of collection and discovery of new knowledge the exploring parties foreseen by Prof. Vernon Harcourt should supply an adequate means providing that each group proceeds under enlightened and inspired leadership. But for the complementary function of dispersal of information a chemical laboratory must depend largely on such well-established media of publication as the journals of the leading chemical societies. The greater part of the published research of the Teddington laboratory has appeared in the Journals of the Chemical Society and of the Society of Chemical Industry, although a certain proportion has been published in the Proceedings of the Royal Society, Journal of the Institute of Metals, and Proceedings of the Institution of Chemi- Engineers. Grateful recognition should be recorded for the generous aid afforded by all these learned societies, and special thanks are due to the first two mentioned. It is my personal opinion that this mode of dispersing chemical knowledge should have priority over its publication in official Governmental reports. First, because in this way the information radiates more rapidly to a wider public; thus each of the two chemical journals just mentioned has more than 5,000 registered readers. Secondly, because this form of publication is frequently preceded by a reading and discussion of the subject-matter at a scientific meeting, and lastly, because the financial circumstances of the learned societies compel them to impose a limit on the length of communications which is conducive to brevity and conciseness.

Relations With Other Scientific Institutions.

Apart from substances of therapeutic interest prepared for the Committee on Chemotherapy, numerous other research materials have been distributed to colleagues in the universities and research institutions. Compressed helium and carbon monoxide have been rendered available for scientific workers requiring these gases. Organic derivatives of tellurium have been lent to the Cambridge University Chemical Laboratory for the purpose of physico-chemical measurements, and to the Birkbeck College for the demonstration of the parachor of this element. Compounds of special chemical interest have been supplied to the Davy Faraday Laboratory and to the National Physical Laboratory for the X-ray study of their crystal structure. It is a pleasant duty to refer to the aid received from the Government Laboratory in respect of micro-analyses and in connection with the work on synthetic resins.

Reference has already been made to the close collaboration of the laboratory with H.M. Fuel Research Station in regard to the products of coal carbonisation. Certain preparations from low temperature tar have been submitted to the Cotton and Woollen Research Associations, for examination in connection with the chemical treatment of textile fibres.

Relations With Chemical Industry.

The associations of the laboratory with chemical industry have always been cordial and are daily becoming increasingly intimate. Prominent industrialists either individually or in their corporate capacity as members of the Association of British Chemical Manufacturers and allied organisations have visited the laboratory and sometimes repeatedly.

Arising out of these visits and informal conferences, more than a hundred samples of the research products of the laboratory have been distributed to interested enquirers.

Members of the scientific staff participate in the work of the Committee for the Standardisation of Tar Products Tests, the Bureau of Chemical Abstracts, the Corrosion Committee of the Iron and Steel Institute, and the Council and various Committees of the Society of Chemical Industry.

Although the laboratory is not a teaching institution in the academic sense of the term, yet facilities have been afforded for collaboration in research to chemists in training of approved qualifications. The two leading metropolitan gas companies have seconded to the laboratory for this purpose junior members of their scientific staffs who have worked at Teddington for periods ranging from six to eighteen months. The subjects so far selected for this collaboration have been high-pressure chemistry and low temperature tar.

In the foregoing description of the activities of the new laboratory I have endeavoured to speak as historian rather than as advocate, but if any justification is to be included I would take as the two leading points of my case: First, the scientific and industrial importance of the researches completed and in progress; secondly, the significant fact that of the sixteen members of the laboratory staff who have resigned during the five years, fourteen have gone into chemical industry to occupy positions of considerable importance and responsibility. The appreciation of chemical talent is a valuable function of this State laboratory.

Anticipations and Current Tendencies.

Those who feel sufficiently interested in the realisation of Prof. Vernon Harcourt's vision should not fail to visit the exhibit of laboratory products now on view in an adjacent room, for these specimens, diagrams, models and photographs furnish a record of the researches of this youthful organisation which is far more realistic and appealing than any words of mine can be.

Certain of these investigations have an immediate practical objective; others represent the long view. It is, however, impossible to draw a definite distinction between these contrasted types. The aim of a State laboratory should rather be to encourage a judicious blend of the two.

The chemical preparations now selected for exhibition as representing the work of the first five years are only the more distinctive specimens of a much larger collection which is continually being accumulated and classified. In a similar orderly manner chemical knowledge is being collected and systematised in the files and card-indexes compiled by members of each exploring party. So soon as any particular research

is sufficiently complete it is contributed to the appropriate learned society. Occasionally publication takes the form of patent specifications. By such concerted efforts the laboratory must come to be recognised as a storehouse of chemical information at least for those branches of the science which are included in the scope of its researches.

Is it desirable that this scope should be extended, and if so in what directions? This is not the occasion to discuss matters of departmental policy, but, in my present capacity, I may, like my predecessor of fifty-five years ago, indulge in anticipations of how future developments might be of advantage to chemical science in general and to British chemistry in particular.

Inorganic and Mineral Chemistry.

An eminent authority has recently enquired what has become of inorganic chemistry, and this question is frequently repeated. The present answer is that, so far as this country is concerned, the subject is no longer investigated systematically. British chemists are now for the most part content to leave this work of exploration to their contemporaries in other lands. Yet the British Empire is endowed with mineral resources to an extent unsurpassed by any other nation or empire under the sun. It can scarcely be contended that in this respect we are rendering an adequate account of our stewardship. Although there are a few meritorious exceptions, one may say broadly that there is no sustained British attempt to study the rare earths, the less common alkalis, or the metals of the platinum group. Such chemical curiosities as beryllium, gallium, germanium, indium and thallium rarely excite the scientific interest of our investigators. Yet the chemical study of the less common elements, and especially of those grouped under the disparaging term of "minor metals," is a matter of considerable scientific importance and one which sooner rather than later is likely to yield results of industrial value. If proof of this statement is needed, reference may be made to the inert gases which were first noticed in 1894 and subsequently found by Ramsay and Travers to be five in number. To-day three of these gases are employed industrially.

I have already mentioned low temperature tar which is literally a burning question. The great German combination of chemical factories—the Interessen Gemeinschaft—have recently filed patents describing the catalytic effect of molybdic acid on the hydrogenation under pressure of this intractable material. They claim a clear volatile product obtainable in good yield and suitable for motor fuel. Further investigation shows that this beneficial catalytic influence is peculiar to molybdenum compounds and is not possessed by analogous compounds of the other metals of the sixth periodic family. It certainly pays to study chemically the idiosyncrasies of the rarer elements and their derivatives.

The Organic Chemistry of Vital Products.

At the Bristol meeting of 1898, Prof. F. R. Japp's presidential address to this section dealt with the subjects of stereochemistry and vitalism. He called attention to Nature's method of preparing single optically active substances, and referred to the insufficiency of the mechanical explanation of vitalistic phenomena.

Considerable advances have since been made in our knowledge of the fundamental process of photosynthesis, notably as the result of suggestive discoveries by Prof. Baly and his collaborators, but nevertheless we still have much to learn from Nature in regard to the synthesis of carbon compounds. This study of the products of the vital activities of animal and vegetable organisms was the original province of organic chemistry, and to this circumstance the science owes its distinctive name. During the last eighty years, however, organic chemists have extended the scope of enquiry to many substances which are produced not as the result of vital forces, but through the agency of the laboratory arts.

For instance, the organometallic compounds, which have no counterparts in nature, have received intensive study because of their influence on the development of modern chemical theory, their practical application in many operations of organic synthesis and their utilisation as drugs, weapons of chemical warfare and antidetonants. No objection can be urged against the continued investigation of such important artificial products providing that naturally occurring organic materials are not overlooked.

Prof. Japp's address supplies the philosophic reason for a closer study of the products of vital activity, and at present other more mundane considerations may be adduced in support of such researches.

Political and economic forces are bringing into prominence the urgency for a mutually advantageous interchange of commodities between the constituent nations and colonies of the British Empire, and in this pooling of natural resources organic chemistry must play an essential part. Many of the natural products of the dominions and dependencies are in need of systematic chemical study.

Animal and vegetable fats have been mentioned by an investigator in that field as constituting a neglected chapter of organic chemistry, but the phrase is at least as applicable to many other groups of organic substances, for example : the essential oils, the natural gums and resins, and the numerous product of fermentation processes.

By catalytic reductions, involving high temperatures and pressures, one obtains from the oxides of carbon many members of the homologous series of alcohols, aldehydes, fatty acids and esters. Plant life accomplishes similar results under ordinary atmospheric conditions. A comparative study of these two dissimilar sets of processes is clearly demanded.

The importance of imparting to organic chemistry an increasingly biological bias has been illustrated in a convincing manner by my immediate predecessor, Prof. Barger, so that anything more than a passing reference to this desirable tendency is hardly required of me. Perhaps, however, I should add that in stressing the need of more systematic research in organic and mineral chemistry and in the organic chemistry of vital products, I am convinced that the best results will only be attained if the problems are attacked with the newest weapons which the armoury of modern physics can provide.

The primary object of such investigations is the collection of accurate chemical information, but the workers in these two great fields should be stimulated in every possible way to keep a shrewd look-out for any practical applications of their scientific knowledge. When viewed from this standpoint it will be realised that a State experiment in chemical research such as I have described provides competent and enterprising investigators with favourable opportunities for developing their inventive talent in fundamental work of national value and importance.

ON THE CELLULOSES FROM DIFFERENT NATURAL SOURCES. (I).

By Naohiko Matsunami.

The author examined the hypothetical theory that the celluloses from different sources are composed of the same chemical units in the same aggregation. The sources of the celluloses studied were wood pulp prepared from Todomatsu (Abies sacchari-nensis, Masters), grown at Naibuchi, Karafuto, by cooking with sulphite liquor on a manufacturing scale at the Hokuetsu Seishi Co., Nagaoka; Kaoliang culms (Andropogon Sorghum, Broth) grown in Manchuria; and the crude fibres from ramie or China grass (Boehmeria nivea, Hook & Aru) grown in Taihoku, Formosa. From these raw materials, the bleached celluloses were prepared by the Cross and Bevan's method and the chlorine dioxide method proposed b-- E. Schmidt. The wood pulp differs in composition from the ramie fibre-substance, which was assumed to be composed mostly of α-cellulose, and the Kaoliong fibre is a furfural-yielding complex which appears to be hemicellulose compased mostly of xylan.

The impurities or associated substances which occur in cellulose-fibres together with α-cellulose might have some influence on the physical and chemical properties of α-cellulose.

The absorption capacity of alkali of bleached celluloses may be taken as a measure of the difference between the constituents of bleached celluloses in theis chemical nature. The wood and kaoliang-celluloses produced the alkali cellulose of the formula $(C_6H_{10}O_5)_2$: NaOH, while the ramie-cellulose adsorbed NaOH to the amount of a molecular ratio of $(C_6H_{10}O_5)_2$: 2NaOH. The difference between bleached celluloses in their affinity for alkali or dyestuffs may be explained by the difference in the physical state of the surface of the celluloses.

The effect of the treatment of the fibres with strong caustic soda solution, which is called "mercerisation" of celluloses, is to remove β-cellulose, some hexosans other than cellulose and pentosans associated with α-cellulose, and to produce come physical and chemical changes on the surface of the fibres, such as shrinkage, The portion of the bleached fibres undissolved by the strong solution of sodium hydroxide was, therefore, employed to decide the indentity of the wood and Kaoliang-celluloses with ramie cellulose by comparing the physical and chemical nroperties. The cellulose by comparing the

physical and chemical properties. The cellulose mercerized with caustic soda solution are in general, characterised by their high content of a-cellulose and hydrated-cellulose, and the ramie-cellulose is distinguished from the others by its high content of oxy-cellulose, wood cellulose by its high lignin content as indicated by the reducing action, and Kaoliang by the furfural- yielding substances.

The action of superheated water is regarded as an agency comparable to that at work in nature. The action of superheated water on bleached celluloses was therefore investigated in order to get some idea of the difference between a-celluloses abtained from the different fibres. The portion of the celluloses undissolved by the superheated water was found to consist mostly of a-cellulose. It was analysed and the results were compared with those obtained in the case of the mercerized celluloses. The most marked difference noticed in these insoluble residues from three bleached celluloses is in the content of a-cellulose and furfural yielding substance, and the same is also met within the alkali mercerised celluloses. As a matter of fact, crude fibres prepared from different sources were diverse in their properties and on purifying they tend to approach, to some extent, a chemically identical substance.

COMBUSTION STEAM GENERATORS.

The fact that the Combustion Steam Generator has now advanced beyond the experimental stage and is accepted as an efficient and reliable steam raising unit, is evidenced by the number of such boilers already operating or under construction in various parts of the world. We recently announced that four boilers of this design were to be installed in the extensions to Brimsdown Station of the North Metropolitan Power Station Co., Ltd., and we are now informed that Combustion Engineering Corporation have received an order from the Solvay Process Co., New York, for a Combustion Steam Generator.

The boiler will have a heating surface of 15,671 sq. ft. and will be fired by two unit mills with tangential burners. The Flue Gas Heat Extraction equipment will comprise a twin plate type Air Heater.

This order brings the number of Combustion Steam Generators up to forty, a remarkable figure considering the short time that has elapsed since the first unit was constructed as an experimental boiler.

SALT CAKE.

By H. O. MORAW.

Chemical Division, U.S.A. Bureau of Foreign and Domestic Commerce.

The United States requirements of crude sodium sulphate or salt cake, as it is known in the trade, until 1927 were supplied from domestic production, with the exception of 3 to 5 per cent. The imports until 1927 never exceeded 6,300 tons (1926), but rose to over 11,000 tons in 1927, 28,200 in 1928, and 91,100 in 1929.

This rapid growth of imports in just a few years was the result of both increased demand and diminished production in the United States. Although this product is one of the basic raw materials for several important industries—the heavy chemical, rayon and textile, glass and ceramics—its largest use is for the manufacture of kraft paper stock. The increased activities in these branches, and particularly in kraft pulp manufacture, in the last two years have added materially to the demand for salt cake. Production of kraft pulp in the United States advanced from 523,900 tons in 1926 to an estimated 1,000,000 in 1929.

NITRE CAKE USED AS SUBSTITUTE FOR SALT CAKE.

Coincident with the increased consumption of salt cake, changes were taking place in the processes of producing hydrochloric acid from which branch the major portion of the United States output of salt cake has been obtained as a byproduct (208,565 tons in 1927), and of producing nitric and sulphuric acids, from which nitre cake is a by-product and from which salt cake also may be produced cheaply. To-day, by-product salt cake from the old hydrochloric-acid process has been largely eliminated by the use of the process of direct synthesis of this acid from chlorine and hydrogen gases. The major of the nitric acid is produced by oxidation of ammonia, as well as nitrous oxides for sulphuric-acid plants, so that both the salt-cake and nitre-cake supplies as by-products from these processes have been diminished to the extent of the replacement there of by these new installations.

Nitre cake, formerly regarded as a waste product, was valued chiefly because of its sulphuric-acid content, varying from 35 to 35 per cent. Its chief use was as a substitute for that acid for producing salt cake, metal pickling, absorbing ammonia, and acidifying phosphate rock. With the scarcity of Salt cake supplies, nitre cake, which has

been produced at the rate of 150,000 tons annually, was called into use as a substitute, so that the surpluses heretofore maintained were consumed. Larger quantities were used incidentally in the last few years in ore and metallurgical operations.

United States Sodium Sulphate Resources Large, Output Limited.

Authorities in the United States estimate of the Great Salt Lake at 30,000,000 tons, and sodium chloride at 400,000,000 tons. Near this lake are also located extensive smelters from which the fumes could be treated to produce large supplies of sulphuric acid. This acid could then be combined with the sodium chloride to supply large quantities of salt cake, if it could be economically transported to consuming centres. Estimates of the tonnage of sodium sulphate in all the important deposits of the United States have not been published but one of the more important, located in Arizona, was estimated by trade authorities to contain about 25,000,000 tons.

The small proportion of the total consumption in the United States supplied by the natural product is evidently partly ascribed to such economic factors as the cost of production and transportation to points of consumption. The production of the different forms of sodium sulphate in the United States between 1919 and 1927 is shown in the following table :

United States Production of Sodium Sulphate.

(Quantity in short tons).

	Total—Natural	For sale—Artificial		
Year	sodium sulphate	Salt cake	Glauber's salt	Nitre cake
1919	......	122,908	38,330	81,107
1921	5,000	95,095	52,041	48,965
1923	10,800	141,017	66,192	129,447
1925	9,940	140,843	57,622	101,596
1927	23,080	174,992	53,420	120,506
1929	7,540	....	....	....

TURKISH GOVERNMENT CONTRACT TENDERS.

The Commercial Secretary to H.M. Embassy, Istanbul, has prepared a Memorandum for the guidance of United Kingdom firms desirous of submitting tenders for Turkish Government contracts.

United Kingdom firms interested may obtain copies of the Memorandum on application to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1 (quoting reference C.3351).

SELENIUM AND TELLURIUM.

Some up-to-date information on these two elements has been released by the U.S Bureau of Mines, Circular 6317. These elements come in the oxygen sulphur group. Selenium exists in three allotropic modifications, amorphous, vitreous and metallic. The last is obtained by heating vitreous selenium, the metallic phase, forming at 217°C. with a gravity of 4.8. This is the only modification that conducts electricity. Selenium boils at 700°C. The unique property of selenium is that the electrical resistance is lowered upon exposure to light. The action is produced principally by the red rays and is proportional to the intensity, but the change is not instantaneous. This particular property has caused the development of the selenium cell. Other industrial uses are the flame proofing of switchboard tables; as a vulcanizing and accelerating agent in rubber manufacturing; and as a colorizer and decolorizer in glass and pottery industries.

The inertia of selenium cells has been reduced to a minimum and the possibility of using these for television purposes is again being investigated. The principal use for any quantity of selenium is in the glass industry for the production of ruby glass and ruby glazes in the ceramic industry. The selenium is added either as the metal or element or as sodium selenite in the proportion of about one-half ounce to one thousand pounds of sand, together with Cobalt oxide to one-eighth of its weight to correct the muddiness which remains after selenium colorization.

Another possible use of selenium is as a solent. Selenium oxychloride is a most powerful solvent and will readily dissolve phenolic resins, such as bakelite. In the refining of copper, selenium and tellurium are found in the slime, combined with silver and copper to form selenides and tellurides.

During the ordinary furnace treatment, part of the selenium is condensed in the flue system or caught in the solutions from the cottrell precipitation. It is recovered by oxidation, leaching, precipitation, and finally by distillation.

The price in the United States has varied from $1.24 a pound in 1922 to $1.78 a pound in 1927, with sales in that year amounting to 284,508 pounds. The supply still exceeds the demand. Imports come

largely from Germany and Mexico. The Japanese selenium goes chiefly to Europe. Selenium is generally sold in the form of an amorphous powder, approximately 99 per cent. pure. During 1929 the average price for selenium in the United States was $2.18 per pound.

Metallic tellurium is used as a crystal detector in radio work; as a colouring agent in certain glass and ceramic ware; in photograhy to give silverware a black finish and as diethyl telluride, as an anti-knock compound for gasoline. In photography, a solution of tellurium dissolved in a sodium sulphide solution is used in the toning or colouring of prints when it is required to give them a brownish tint. A solution of tellurium oxide and hydrochloric acid is used as a dip for silverware to give a black finish. Studies on the metallurgical side have been made with these elements. During 1929 the price held between $2.25 and $2.70 a pound.

Canadian Chemistry & Metallurgy.

SCIENCE AND THE WORLD'S FOOD SUPPLY.

THE LATE SIR WILLIAM CROOKE'S DREAM REALISED.

In connection with the British Association meeting at Bristol, Dr. R. E. Slade, an expert in Synthetic Ammonia production gave an address on "The Nitrogen Industry and our Food Supply" He mentioned that Sir William Crookes's presidential address to the association at Bristol 32 years before, in which he apprehended a world shortage of wheat and suggested that some means of fixing nitrogen must be found so that the yield of wheat could steadily rise. Since then there had been improvement in agricultural methods, making it possible to grow wheat in dry areas, and the discovery and use of breeds of wheat which would ripen in a shorter summer, thus pushing the wheat growing area farther north. The yield per acre, estimated at 12.7 bushels, had since risen to between 13 and 14 bushels, but this supply was due to the use of nitrogen fertilizers.

For many centuries nitrogen had been used as a fertilizer in the form of farmyard manure, and certain rotations of crops which kept up the nitrogen content of the soil had been popular. But it was not until 1840 when Liebig first pointed out the true function of nitrogen, phosphorus, and potash that fertilizing became an art based on science. From 1840 the use of nitrogen in the form of Chili nitrate steadily increased, and about 1880 ammonium sulphate became available from by-product coke ovens. By 1903 the world consumption of these two fertilizers had increased to 1,975,000 tons, equivalent to 351,000 tons of nitrogen. In 1905 calcium cyanamide was manufactured on a commercial scale for use as a fertilizer, and in the same year the arc process for combining oxygen and nitrogen of the air to form nitric acid was launched unsuccessfully in Canada. Two years later, in 1907, the arc process was established in Norway, and calcium nitrate was put on the market as a fertilizer.

Thus Crookes's dream of the commercial production of nitrogenous fertilizers from the nitrogen of the air was realised in less than 10 years. But it was the Haber-Bosch process for the fixation of nitrogen which was to supersede all others and make possible the production of all the nitrogen fertilizers required for the present and as far in the future as one could see. The fixation of nitrogen in the form of ammonia was so much cheaper than by any other process that it had very largely replaced the cyanamide and other processes, and had shaken the Chili nitrate industry to its foundation.

During the year 1928 the world's consumption of nitrogen in all artificial forms, including Chili nitrate, was 1,843,000 tons, of which 10 per cent. was used in industry and the remaining 1,658,000 tons as a fertilizer. The capital required to build a works to produce fertilizers to feed one person, Dr. Slade said, was only £3, and the only other alternative, as Sir Daniel Hall had pointed out, was to bring 2½ acres of new land under cultivation, the estimated cost of which was at least £25. It was therefore more economical in capital at the present time to provide for the increasing population of the world by more intensive cultivation of land now farmed than to open up new areas.

He suggested that these countries should rather devote their attention to making full use of the land already cultivated near their consuming centres or on roads and railways. If the whole increase of population of the world—10,000,000 a year—was fed with food produced from nitrogen fertilizers it would be easy to build the works to fix this nitrogen and find the coal and power to drive them for the next 100 years. There were still large areas of the world to be brought under cultivation, so there should be no food shortage for several generations.

At present some 56,000,000 people in the world were being supported by the food

from artificial fertilizing. In Holland in 1928 one third of the crops were derived from nitrogen fertilizers. In England our agricultural efficiency was high, so that we got a good deal from the land—as much and more than Holland and Belgium would without the use of nitrogen. But there appeared to be no reason why we should not use more nitrogen and obtain as much from the land as was done in Holland and Belgium. It paid to use nitrogen fertilizers at their present price.

KENYA THE CRADLE OF MAN.

In a recent lecture Mr. S. B. Leakey, leader of the East African Archæological Expedition 1926-29 said that the development of the Stone Age cultures in Kenya, was intimately bound up with the great climatic changes, and a remarkable fact was that, with certain very important exceptions the culture sequence in Kenya was identical with that in Europe. The earliest well-defined European culture was that known as chello-acteulean, and although Kenya was several thousand miles away from Europe the tools of this period were so similar to those of this culture in Europe that they could only be distinguished by their difference in material. An identical culture was also the earliest in South Aprica. Little was known about the human type responsible for making this culture, and in Africa no human remains were known which could be assigned to this period. As in Europe, the Mousterian culture followed, but as no remains of the men who made this culture in Africa had been found it could not be ascertained whether it was made by a Neanderthal type of man or not.

From the beginning of the second main pluvial period onwards there was clear evidence that in Kenya, unlike Europe, the Mousterian and Aurignacian cultures existed side by side, each developing along its own lines. The Kenya Mousterians appeared to be as primitive as their European cousins but the Aurignacians, on the other hand, had a well-developed culture, and from their skeletons it was known that they were definitely ancestors of modern man.

It was in connection with this contemporaneity of the Aurognacian and Mousterian cultures in Kenya that the question of the exact correlation of the glacial periods of Europe and of the pluvial periods of equartorial Africa became so important. With the evidence as it stood at present it seemed that in Europe the Ice Age fluctuations consisted of two ice advances separated from each other by a comparatively short, warm, inglacial advances. Theoretically, it looked as though the long inter-pluvial which separated the two big main pluvial periods in Africa, and if this were the correct correlation the Aurignacian culture started very much earlier in Kenya than in Europe.

Nor was this unlikely if the position was looked at from another angle. The first Aurignacian folk arrived in South Europe from Africa and already had well-developed culture. This suggested that Kenya was nearer the place of origin of modern man than was Europe. The problem of the locality of the cradle of man of modern type was, however, still unsolved.

VETERAN SCIENTIST ON SPIRITUALISM.

Like the late Sir William Crookes founder of *The Chemical News*, the well known scientist Sir Oliver Lodge is a sympathetic investigator into the mysteries of Spiritualism. While attending the annual meeting of the British Association at Bristol Sir Oliver Lodge delivered an interesting address on Sunday evening, September 7th, at the David Thomas Memorial Church, Bishopston. Within the last century, he stated, there has been instances of scientific men who felt that the spiritual region was not so closed as they had been taught, that the aim of scientific inquiry ought not to be limited to the material order of things and that in certain aspects the spiritual order offered a few channels for scientific exploration.

Some of the general public were interected in their research, and produced continually fresh facts for investigation. These were the sect known as spiritualists, who had become acquainted with a number of phenomena and had formed their own conclusions.

Already they had discovered that mind could operate independently of brain, that a person was necessarily limited to the performance of the organs of his body, that there existed individuals who could send messages mentally, and other individuals who could receive them. They called this process "telepathy," and though it was not yet accepted by orthodox science, the fact that ideas could be thus somehow transmitted was becoming more and more recognized by reasonable people. The poineers did not stop there, however; they said if mind could operate apart from matter, if mind and brain could be thus disconnected, then the

mind might continue its existence after its bodily organ had been destroyed; and they adduced much evidence that this was actually the case. They asserted that they were in touch with people who had lived and who had departed this life, people who had lost their natural bodies and nevertheless continued to exist: they held, in fact, the doctrine of individual survival, and adduced plenty of evidence in support of it.

Whether that evidence amounted to proof was still a matter of opinion. Scientific proof was a serious thing, not lightly to be testified to; but the evidence was certainly very strong, and for practical purposes had convinced some of the pioneers, of the fact that they and their friends would survive.

So far he had spoken impersonally. In conclusion, he would say a word on the personal side, and state the general conclusions to which he had been led by the facts known to him. These were, he said, "first, that we are incarnations of spirit here and now, spiritual beings in contact with inert matter for a time, and so living on this planet for something under a century. Earth-life appears to be an episode of considerable importance in the history of a soul, and in many cases appears to be the beginning of an individual existence or personality. Certainly the individual continues thereafter, and carries with him his power, his memory and his affection.

"We have concentrated too much upon matter, and have attended too little to the possibilities of space. Already science is discovering that all activity, all energy, all spontaneity, is to be traced to the properties possesed by what we call empty space, that the matter that appeads to our senses is a comparatively trivial interruption of its continuity, with a function purely demonstrative. The atoms of matter show what is going on in space, they have no initiative of their own, they are pushed hither and thither, and take the path of least resistance. All the genuine activity has hitherto eluded us, we have been studying pointer-readings, and are only now beginning to realize the immensity of the powers which move those pointers and bring about all the phenomena, some of which we are familiar with and others that so far only a few believe in. The real fact is that we are familiar with

and others that so far only a few believe in. The real fact is that we are in the midst of

a spiritual world, that it dominates the m

GENERAL NOTES

TREND OF VITAL STATISTICS.

Lower Death Rate.

There were more births and fewer deaths in England and Wales in the quarter ended June 30 than in the corresponding quarter of 1929. The Registrar-General's quarterly return shows that the live births registered numbered 170,212, an increase of 600 over the number recorded in the second quarter of 1929, while the 111,358 deaths registered were 20,593 fewer than in the preceding quarter, and 7,409 fewer than in the cohresponding quarter, of last year.

Of the live births 86,650 were males and 83,562 females. The annual birth-rate works out at 17.2 per 1,000, and equal to that in the second quarter of last year, which, excepting 1919, is the lowest rate recorded in the second quarter of the year since tre establishment of civil registration.

The deaths comprised 57,444 males and 53,909 females, giving a rate of 11.8 per 1,000, or 0.7 per 1,000 below that recorded during the second quarter of last year. The mortality of infants under one year of age was equal to 57 per 1,000 registered live births, and was the lowest recorded in any second quarter.

The natural increase of population by excess of births over deaths was 58,859, as against natural increases of 63,183, 56,255, and 50,851 in the corresponding quarters of 1927, 1928, and 1929.

AMMONIUM PHOSPHATE PRODUCTION IN FRANCE.

The Pierrefitte plant of the Societe des Phosphates Tunisiens commenced production of phosphoric acid during 1929 by the electric furnace process. The total output of acid in 1929 was 2,220 tons and of ammonium phosphate 458 tons. Certain mechanical difficulties which develope were overcome in January, 1930, resulting in an increase in the output of ammonium phosphate to 3,255 tons during the first four months of 1930. A Soulom plant of the company produced 6,500 tons of synthetic ammonia in 1929 as compared with 5,700 in 1928. In addition to commercial nitric acid the company produced 23,130 tons of calcium nitrate and 786 tons of sodium nitrate which was approximately the output as reported for the previous year.

NOTICES OF BOOKS.

The Scientific Achievements of Sir Humphry Davy. By J. C. GREGORY, B.Sc., F.I.C. Pp. viii + 144. London : Humphry Milford, Oxford University Press. 1930. Price 6s.

The centenary of Sir Humphry Davy's death in 1929 has prompted Mr. Gregory to review this distinguished scientist's work in the light of subsequent developments. Day's life and works were the subject of biographical volumes soon after his death. Dr. Paris's "Life of Sir H. Davy" appeared in 1831 and Dr. John Davy, brother of Sir Humphry was so "disturbed and annoyed by the nature of Dr. Paris's work' that he hastened to publish his own "Memories of the Life of Sir Humphry Davy" which appeared in 1836 and was followed in 1839-40 by "The Collected works of Sir Humphry Davy, Edited by his brother, John Davy, M.D., F.R.S.

From these sources and also from contemporary reviews, the present author has obtained material for his admirable sketch of the scientific accomplishments of a distinguished chemist who had rapidly risen to fame partly by good fortune and partly through his own efforts and genius. That he made mistakes is recognised by all, that he was jealous of rivals and contemporaries (Faraday among others) seems to be established, yet he undoubtedly made brilliant discoveries and advanced the science of chemistry by his work.

He began by making observations on various gases, repeating the experiments of others on oxygen and nitrous oxide which had attained a vogue among society on account of the hilarious sensations it sometimes produced in those who inhaled it.

The remarkable phenomena exhibited by Volta's 'pile' and 'crown of cups' introduced Davy to electrical phenomena and led to his discovery and isolation of the alkali metals, perhaps his outstanding achievement. In chemical philosophy much of his speculations are now of little value, although he established the elementary character of chlorine and the nature of 'euchlorine.' The chemistry of Iodine and Fluorine was advanced by his experimental results and he made valuable contributions to the analysis of minerals. By his choice of spectacular experiments and a selection of popular topics he appealed to 'society' and so attracted an influential audience to his lectures at the Royal Institution which began to flourish from the time that he was appointed Lecturer in 1801. He had been made a fellow of the Royal Society at the early age of 24 and in 1820 he became its president.

His interest in applied science began when he studied the process of tanning in order to deliver a series of lectures on the subject. Later he took an interest in agricultural chemistry and, most important of all, he utilised a scientific knowledge of combustion phenomena to invent a safety lamp for use in mines.

Mr. Gregory has traced Davy's scientific career with reference to his own developments and his indebtedness to earlier and contemporary workers and thinkers (e.g. Dalton) and the present volume constitutes an interesting account of the scientific knowledge at the beginning of last century.

A brief introduction to the use of Beilstein's Handbuch der Organischen Chemie by Dr. E. H. H. HUNTRESS. Pp. viii + 35. London : Chapman and Hall, Henrietta St., W.C. 1930. Price 5s.

The usefulness of Beilstein's Handbuch has been somewhat restricted in the past owing to the fact that students have been unable to use it to the best advantage. The present pamphlet is intended to explain the method followed for the classification of organic compounds. This Prager-Jacobson method is comprehensive and once mastered enables the organic chemist to locate any known compound provided it is described in one of the volumes of Beilstein already published. The magnitude of the work involved in compiling this treatise in which it is intended to include every known organic compound has resulted in indexing difficulties so that it is often more convenient to locate a substance by following the systematic arrangement than from the indexes of the separate volumes.

CHEMICAL MARKETS MEDAL.

Commemorating the Tenth Anniversary of William Haynes as publisher of CHEMICAL MARKETS a gold medal has been designed and will be awarded by vote of readers to the man who has rendered most distinguished economic services to American chemical industries. For this honor the chemical executives named below have been nominated.

EDWIN M. ALLEN—By George Ade.
L. H. BAEKELAND—By Michael I. Pupin.
HERBERT H. DOW By Henry Ford.
PIERRE S. DU PONT—By John J. Raskob.
GEORGE EASTMAN—By Thomas A. Edison

Forthcoming Events.

SOCIETY OF PUBLIC ANALYSTS.

The next Meeting of the Society will be held on Wednesday, October 1st, at the Chemical Society's Rooms, Burlington House, Piccadilly, London, W.1., at 8 p.m.

The following papers will be read :—

" Scientific Evidence relating to Firearms with special Reference to a Recent Murder Trial " by G. W. Baker, F.I.C. As the author cannot be present, Mr, G. H. Perry, O.B.E., B.Sc., F.I.C., the War Department Chemist, has kindly consented to read the paper and to demonstrate the evidence.

" The Composition of Rye Oil." By J. W. Croxford, A.I.C. (Work done under the Analytical Investigation Scheme.)

" The Determination of Unsaponified Oil in Soap or Fatty Acids." By G. E. Lester Smith, M.Sc., A.I.C.

UNIVERSITY OF MANCHESTER. FACULTY OF TECHNOLOGY.

The new session of the University of Manchester, which extends over forty weeks begins on Thursday 2nd of October, and students will be enrolled on Monday, Tuesday, and Wednesday, 29th and 30th September and 1st October.

The College of Technology offers systematic training in the principles of science and Art as applied to Mechanical Engineering, Electrical Engineering and Municipal Engineering, the Building Trades; the Chemical industries; the Textile Industries; Mining and Photography and the Printing Crafts.

The College possesses extensive laboratories and workshops equiped with fully sized modern machinery, tools and apparatus, including not only machines of the type now in general use, but also machines especially constructed for demonstration, experiment and originad research.

In 1824 the Manchester Mechanics Institution was founded from which the Municipal College of Technology has developed, until to-day it is of University rank and attracts students from all parts of the world.

The principals or heads of departments will be pleased to advise students at the commencement of the session as to the courses they should take.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

26,221.—Edeleanu Ges.—Treatment of hydrocarbon oils with liquid sulphur dioxide. Sept. 2.

26,419.—Green, H. and Hatfield, W. H.—Apparatus for use in chemical &c. processes. Sept. 4.

26,085.—(I. G. Farbenindustrie Akt.-Ges). —Manufacture of stable organic acid esters of cellulose. Sept. 1.

26,213.—(I. G. Farbenindustrie Akt.-Ges). —Manufacture of nitrogenous vat dyestuffs. Sept. 2.

26,212.—I. G. Farbenindustrie Akt.-Ges.). —Manufacture of vat dyestuff of benzanthrone series. Sept. 2.

Specifications Published.

334,207.—British Celanese Ltd., Green, S. J., and Handley, R.—Manufacture of acetic acid.

334,262.—Carpmael, A. (I. G. Farbenindustrie Akt.-Ges.).—Process for the manufacture of carbohydrate compounds.

314,060.—Oehme, H., and ChemischeFabrik Kalk Ges.—Process for the manufacture of carbon, bi-sulphide.

Abstract Published.

332,359.—Potassium nitrate.—Hofer, P., and Kaliforschungs-Anstalt Ges., 5, Schonebergerstrasse, Berlin.

Potassium nitrate is produced by the action of potassium chloride on the nitrate of a readily hydrolysible metal, for example, aluminium or iron. The mixture, if hot, is cooled to separate potassium nitrate. The mother liquor is evaporated with the evolution of hydrochloric acid gas, either until nitrous gases begin to escape, or until most of the chlorine has been expelled from the solution. Water, potassium chloride, and nitric acid or nitrogen oxides are added to restore the original concentration. The solution is cooled, potassium nitrate separated, and the operations repeated.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

GLACTIS.

512,853.—Chemical substances used for agricultural, horticultural, veterinary, and sanitary purposes.—E. J. Reid and C., Ltd., 35, Gordon Square, London, W.C.1. Sept. 10th. (By Consent).

PUREMO.

514,636.—All goods in class 2 which includes chemical substances used for agricultural, horticultural, veterinary, and sanitary purposes.—Leslie Lonsdale, Ltd., Millside Works, The Mill. High Street, Bexley, Kent. Sept. 10th.

BONDERITE.

509,711.—Chemical substances, included in Class 1, for use in conditioning metal surfaces preparatory to enamelling. Parker Rust Proof Co., 2177, East Milwaukee Avenue, Detroit, County of Wayne, State of Michigan, United States of America. Sept. 10th.

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BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

BRISTOL, 1930.

SECTION I.—PHYSIOLOGY.

THE SYNTHETIC ACTIVITIES OF THE CELL.

By PROF. H. S. RAPER, C.B.E., F.R.S.,
President of the Section.

It has long been the custom to divide the chemical transformations which occur in living animals into anabolic and catabolic. The anabolic are associated with those processes of restitution which occur after functional activity and the catabolic with those accompanying the functional activity itself. This distinction must not be taken to imply that they are independent. In certain instances we know that the reverse is true. Hence the synthesis of one substance may require the concurrent degradation of another.

A review of present-day knowledge of chemical processes in the cell reveals the undoubted fact that physiologists have been more successful in investigating the phenomena of catabolism and chemical degradation in the cell than the processes of synthesis, although during life they may and do occur together. This might be expected. Catabolic processes may persist long after the cell has ceased to possess those fundamental properties which we associate with life. They may be demonstrated in cells which have been submitted to mechanical injury so as to destroy their structure or after various methods of treatment have been applied to extract the cell contents. Their investigation has thus proved relatively simple because restrictions as to experimental method have not been severe. But the anabolic processes of the cell are essentially those which occur only during life. To study them successfully demands that the cells in which they are taking place must be kept alive during the investigation. This in itself implies that the range within which the factors determining their progress or cessation can operate is probably as restricted as the conditions determining the life of the cell itself. It is not surprising then that with such severe limitations we have learned up to the present a great deal more about degradation than synthesis in the cell. Nevertheless, the synthetic activities of the cell have a fascination which in itself makes an attempt to discuss them attractive. And I must

confess that it was partly for that reason that I chose the subject of this address. It was also my good fortune before proceeding to the study of physiology to pass through a school of chemistry and this may explain in part my predilection for the synthetic processes of living organisms. The chemist, if I am not mistaken, is more proud of his achievements in the synthetic field than in the analytic. There is more artistry about them. They are examples of the creative instinct by means of which man from the earliest days has striven to conquer Nature. But there is another reason for my choice of the subject. A little more than a hundred years ago the first synthesis of a product of animal life from inorganic matter—the production of urea from ammonium cyanate—was described by Wöhler. It seemed to me therefore an appropriate time to consider the bearing of the achievements of organic chemical synthesis on our understanding of synthetic processes in the living animal.

Wöhler's discovery did not bear immediate fruit. It required the genius of Kekule with his hypothesis of the tetravalency of carbon and the mode of linking of carbon atoms to point the way to a rational method of illustrating the structure of carbon compounds, an organ of thought as valuable as language itself.

Once the structure of compounds could be pictured objectively it became possible to build them up from others of known structure. How aptly this exemplifies the dependence of progress on man's ability to illustrate his conceptions pictorially! Kekulé's hypothesis came thirty years after Wöhler's synthesis, but from that time on we have seen and acclaimed the discovery of the structure, in many instances confirmed by synthesis, of a large number of organic substances which are produced by living organisms. This discovery of the structure of products of cellular activity is of prime importance to the physiologist. Structure is the point from which we must always start when trying to find out how any particular substance is made in the cell. For this contribution to the solution of our problem of synthesis, if for no other we owe organic chemistry a great debt. But the methods used by the chemist in synthetic processes have usually been such as could have no place in the living cell with its extreme sensitiveness to conditions such as temperature, reaction of the environment and osmotic pressure, to mention only the more obvious ones. The use of high temperatures to bring about activation of the reacting substances is inadmissible. Activation in the living cell must be achieved by other means. Acids and bases, except in such strength as will bring about only small changes in hydrion concentration, cannot be employed. All reactions must take place in an aqueous medium. With these and other limitations it can readily be appreciated that a few only of the usual processes of organic synthesis can be considered as operative in the cell.

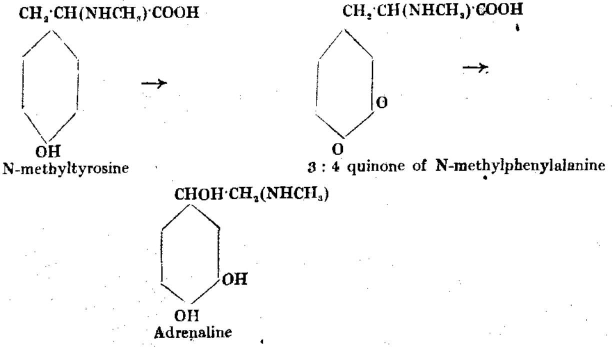
It is not possible within the scope of this address to consider all the aspects of synthetic activity which are found in living organisms. Each one presents almost a distinct problem. I propose, therefore, to deal only with the animal cell, since its range of synthetic activity is narrower than that of vegetable cells and has been more closely studied, and only with the synthesis of a few substances which exemplify certain general problems.

Unlike the Chemist, the animal cell has a very limited choice of raw materials from which synthesis must start. These are the components of the common foodstuffs. When they have undergone the preliminary processes of digestion they provide in all about thirty substances which may be regarded as available for the building up of new compounds by the cell. They consist of about twenty amino-acids, two purine bases, three pyrimidine bases, three hexoses, glycerol and higher fatty acids. It is true that there may be other, hitherto undiscovered components of foodstuffs, which are important as raw material for synthesis in the animal cell, but they can be but few in number and present in small amount. Given this list of raw materials can we in every instance indicate which is the likely starting point for the synthesis of substances whose constitution is known or partly known? This question must still be answered in the negative for such well-known products as cholesterol and the unconjugated acids of the bile. It is possible that the experiments of Chapman who demonstrated that addition of spinacene to the diet of rats caused the cholesterol content of the liver to increase to double its usual amount may afford a clue to the origin of this substance, but it is difficult to conceive of spinacene being the raw material for this synthesis in the herbivorous animal. As

for the bile acids, we are in complete ignorance of the substance or substances from which they are built up. Although closely allied in structure to cholesterol it is clear from the careful experiments of Enderlen, Thannhauser and Jenke, who failed to observe any increase in the production of bile acids in dogs after long periods in which cholesterol was added to the diet, that they are not produced from this substance.

With the purine bases, which are components of nuclear material and therefore present in all cells, this question of indicating the probable raw material for their synthesis must also be answered in the negative, but with less emphasis than in the case of cholesterol and the bile acids. The amino-acid histidine, which contains a five-membered ring similar to that found in the purine bases, is their most likely precursor on structural grounds. But we have as yet no experimental evidence that indicates clearly their origin from this amino-acid in the body. Until this has been proved it is perhaps useless to speculate as to the chemical processes involved in the transformation. The synthesis of cholesterol, that of the bile acids and of purine bases are therefore still problems in the purely chemical sense. When the chemist has indicated their likely solution it will be the task of physiology to find out the mechanism by which the cell brings about the necessary chemical processes.

An example of a synthetic product which bears a fairly close structural relationship to two of the amino acids which are found in proteins is adrenaline. These two amino acids, phenylalanine and tyrosine have adrenaline. Either of them might give rise to adrenaline by successive oxidation, methylation of the amino group and loss of practically the same carbon skeleton as carbon dioxide. That a part of the necessary oxidation process can be brought about by means of an oxidising enzyme has already been demonstrated. This enzyme, tyrosinase, will oxidise tyrosine to 3 : 4-dihydroxyphenylalanine. It is therefore conceivable that the first stage of the synthesis from tyrosine occurs in this way in the cell. The enzyme does not attack phenylalanine so that this seems less likely as a precursor than tyrosine although there is evidence that in other respects the metabolism of these two amino acids is closely related. In N-methyltyrosine we have an amino acid which is more nearly related to adrenaline than tyrosine, since in both the amino group is methylated. By the introduction of two atoms of oxygen in the appropriate positions and loss of carbon dioxide it should give rise to adrenaline. It is of considerable interest that on oxidation with tyrosinase a small amount of pressor substance is obtained. It is not possible to say as yet whether this is adrenaline. The amount produced represents only a small proportion of the reaction products, but it brings nearer the possibility that a methylated tyrosine by simple oxidation under the influence of an enzyme might give rise to adrenaline by the following scheme of reactions :—



If, however, we consider how we may find out whether a process of this kind, operating in the cells of the adrenal gland under specific conditions, gives rise to adrenaline, many difficulties appear. One method of approach would be to find the conditions under which a production of adrenaline by the medullary cells of the gland occurs and then under these conditions determine whether introduction of tyrosine or possible intermediate products in the synthesis leads to an increased formation. But these conditions are not as yet defined. Attempts have been made by exposing the glands freshly removed from the body to solutions of tyrosine but no production of adrenaline has been demonstrated. Neither is there any evidence that the cells of the gland can either oxidise tyrosine in the same way that the enzyme tyrosinase does, or methylate it. The possibility has to be borne in mind also that even if tyrosine be the mother substance of adrenaline the processes requisite to produce adrenaline from it may not all take place in the adrenal gland. In that case the effect of hypothetical intermediate products on adrenaline formation would have to be tried. But methods of this kind are relatively crude. If they fail it does not necessarily mean that the hypothesis as to the gross chemical mechanism is wrong. When we remember that the oxidation of one substance may only take place if another is reduced; that a reaction taking place in one compound may only be possible when some other reaction takes place along side it, in other words, that in the living cell there is a continuous and complex interplay of chemical reactions; then it is not surprising that the discovery of the mechanisms by which adrenaline is formed, although a simple problem at first sight, is probably in reality very complicated.

The case of thyroxine is comparable with that of adrenaline. Thyroxine is a relatively simple chemical substance which could conceivably be produced by the oxidation of diodotyrosine. The last named compound has recently been shown to be present in the thyroid gland and this makes the presumption that it is the mother substance of thyroxine all the stronger. Yet it has not been demonstrated either *in vitro* or *in vivo* that thyroxine may be produced from diiodotyrosine.

These two instances of adrenaline and thyroxine show that even when there is a reasonable presumption that we know the raw material from which the synthesis in the cell starts and the chemical processes concerned the proof that our hypotheses are correct is far from simple.

We may now pass on to consider a process in which the raw material is known with certainty but the chemical reactions by which the synthesis takes place are relatively obscure. I refer to the production of fat from carbohydrate. Lawes and Gilbert in their classical experiments at Rothamsted on the fattening of farm stock, showed indubitably that animals can produce fat from starch. It has been confirmed since by others. Since the starch is converted into glucose in the alimentary canal prior to absorption we may consider glucose as the starting point of the synthesis.

It involves the production from hexose units of straight carbon chains of 16, 18 and 20 or more carbon atoms such as are found in the naturally-occurring, higher fatty acids. The carbon atoms are present in even numbers and the carbon chains may be completely saturated or partly unsaturated. Any series of reactions which is put forward to explain this synthesis must therefore take into account these elementary facts if no others. The origin from carbohydrate at first sight suggests the coupling of hexose units end to end although this would only suffice to explain the production of acids containing multiples of six carbon atoms such as stearic and oleic acids. Such a scheme was put forward many years ago by Emil Fischer but has not found general acceptance. Apart from the difficulty of explaining the production of acids that do not have eighteen but some other even number of carbon atoms, it has never yet been shown that hexose molecules unite end to end using any of the usual methods which bring about the condensation of aldehydes. It is therefore improbable from the purely chemical point of view.

A more likely chemical explanation of the origin of the fatty acids is that they are built up, two carbon atoms at a time from some simple, reactive substance which is first produced by degradation of glucose. Acetaldehyde and pyruvic acid have both been suggested as probable participants in a reaction of this kind, the former condensing with itself, as in the well known aldol condensation, the latter either with acetaldehyde or with some higher aldehyde containing an even number of carbon atoms pro-

duced in the earlier stages of the reaction. By both of these methods it has been shown that *in vitro* aldehydes with an even number of carbon atoms in a straight chain can be built up step by step and these by oxidation can be readily converted into the corresponding fatty acids. Unsaturated linkages in the chain may be produced by either method so that this requirement in the hypothetical synthetic method is also satisfied. Further, the condensation takes place in weakly alkaline solution or under the catalytic influence of certain organic bases, so that drastic treatment is not necessary to bring about the reaction. So far this evidence for the mechanism of synthesis of the fatty acids is purely chemical and the grounds on which it can be put forward are largely chemical ones. Is there any physiological support for this scheme? Studies of the synthesis of fat in animals have yielded very little so far. It was observed many years ago by Leathes that the fat in the liver of some animals might increase in amount if the organ were kept warm and under sterile conditions for a few days after its removal from the body. The addition of glycogen or glucose does not however have any effect on this increase in fat content. The process appears to be determined by something other than a mere excess of carbohydrate, but what this is is not known. It is however known that acetaldehyde and pyruvic acid, the intermediates postulated in the hypothesis just mentioned, can be produced in the body. Neuberg and Gottschalk detected acetaldehyde as a product of decarboxylation of pyruvic acid in the liver and recently Hahn, Fischbach and Haarmann have shown that under anærobic conditions pyruvic acid may be produced in muscle from lactic acid. But there the question rests for the present so far as higher animals are concerned. When we know what the conditions are which set the process of fat synthesis going, and when we are able to reproduce them at will in animals, it may be possible to determine what are the intermediate substances concerned.

More success has been achieved by a study of the formation of fatty acids in micro-organisms, some of which possess this faculty in a remarkable degree. Bacteria which form butyric acid from glucose have been found to produce in addition both lactic acid and acetaldehyde. These same bacteria will also produce butyric acid from pyruvic aldol though not from aldehyde ammonia, aldol or pyruvic acid itself. Neuberg and Arinstein, who investigated this type of fermentation, conclude that pyruvic aldol is the precursor of the butyric acid when it is formed from carbohydrate. This does not negative its production from acetaldehyde, since the addition of sulphites to the fermenting liquid causes a fixation of acetaldehyde and inhibits the production of butyric acid, thus suggesting that acetaldehyde takes some part in the process. But it has also been shown that in this so-called butyric fermentation fatty acids containing an even number of carbon atoms higher in the series than butyric are formed, namely, hexoic and octoic acids. This makes it appear probable that the processes by which these lower members of the series of fatty acids are formed in bacterial fermentation are formed in animals. The production of fat is a process which is common to a great variety of living organisms both simple and complex, animal and vegetable. It is not unlikelv therefore to be carried out by the same series of chemcial reactions wherever it is found.

The intensive study during the last few years of the processes of alcoholic fedmentation and the chemical events which occur in muscular contraction has revealed such close similarities that we are becoming forced to accept the view that certain fundamental activities of the living cell, whether animal or vegetable, may be carried out by an almost identical mechanism. It may therefore be that we shall eventually discover the reactions responsible for the synthesis of fat in animals by investigating the processes by which it occurs in vegetable forms, such as bacteria or moulds. Before leaving the subject of fat synthesis it is worth while to point out the economy of the suggested process of synthesis from lactic acid by way of acetaldehyde. It is a good illustration of the kind of serial reactions which one expects to find in syntheses in the cell and involves only the loss of water and carbon dioxide.

$$
\begin{array}{lll}
(1) & CH_3{\cdot}CHOH{\cdot}COOH & \rightarrow CH_3{\cdot}CO.COOH+H_2 \\
(2) & CH_3{\cdot}CO{\cdot}COOH & \rightarrow CH_3{\cdot}CHO+CO_2 \\
(3) & 2\ CH_3{\cdot}CHO & \rightarrow CH_3{\cdot}CH : CH{\cdot}CHO+H_2O \\
(4) & CH_3{\cdot}CH : CH{\cdot}CHO+H_2 & \rightarrow CH_3{\cdot}CH_2{\cdot}CH_2{\cdot}CHO \\
(5) & CH_3{\cdot}CH_2{\cdot}CH_2{\cdot}CHO+O & \rightarrow CH_3{\cdot}CH_2{\cdot}CH_2{\cdot}COOH.
\end{array}
$$

Repetitions of reactions (3) and (4) would produce aldehydes corresponding to the *higher fatty acids, and only one atom of* oxygen is required for the final oxidation of the aldehyde. All the hydrogen required *for the reduction of the unsaturated alde*hydes would be supplied by the dehydrogenation of lactic to pyruvic acid. But even *if these reactions turn out to be the right* one the problem will still remain as to how they are accurately controlled within the cell. Some of the substances concerned in them are diffusible and very reactive, and *we should have to explain how diffusion* away from the site of reaction is prevented. To overcome difficulties of this kind it is becoming common to invoke the intervention of surface forces. There is, however, not much experimental evidence as yet which helps us to explain by such intervention the mechanism of synthetic processes even of such a simple kind as the reversal of an enzyme action.

Freundlich in his Liversidge Lecture to the Chemical Society last year described experiments on the influence of charcoal in *modifying the velocity of certain reactions.* Bromoethylamine is converted by caustic soda into dimethyleneimine. The amine is *more strongly adsorbed than the imine and* therefore the conversion should be slower in the presence of charcoal than in homo*geneous solution. Experiment verifies this.* Further, dimethyleneimine is converted into bromoethylamine hydrobromide in presence of hydrobromic acid. Because the bromoethylamine hydrobromide is more strongly adsorbed than the dimethyleneimine the *conversion should be more rapid in the* presence of charcoal than in homogeneous solution. This also was shown to be true. In addition it was demonstrated that the change of the amine into the imine in neutral solution stops earlier when charcoal is present than when it is absent. The equilibrium obtained in homogeneous solution is thus disturbed in the sense that the formation of capillary active substances (*i.e.*, those more highly adsorbed) is favoured. It follows from this that the *stability of a substance on a surface may be greater than in homogeneous solution under* similar conditions. It must be borne in mind, however, that in these experiments very large quantities of charcoal were used compared with the amounts of the substances whose equilibria were being studied.

So much so that in the reaction in alkaline solution the bromoethylamine was practically completely adsorbed and the reaction was taking place entirely on the charcoal surface. Can one postulate such conditions *during the continuous synthesis of sub*stances in the cell, glycogen from glucose for example? It seems to me that to explain the rapid accumulation of synthetic products such as far of glycogen which we observe in cells something more than a shift in the equilibrium of the reactions due to surface forces is necessary. Such a condi*tion favouring synthesis could only operate* for a time until the surface became saturated. We must therefore postulate some additional mechanism whereby the synthesised product is removed from the sphere of action, for if it diffused off the surface again it would be subject to the equilibrium conditions which are present in the solution. It may be that the arrangements in the cell are such that only smal amounts of the substrate are dealt with at a time so that complete synthesis is achieved and the synthetic product removed. This implies that the synthetic activity takes place in cycles due possibly to cyclic changes in the activity *of the active surface or to a mechanism* whereby only as much substrate for the synthesis is admitted to the sphere of action *as can be dealt with without saturating* the active surface. It is difficult to translate experiments such as those described by *Freundlich to explain synthesis in the living* cell without additional mechanisms such as these.

*We have also to consider how the syn*thetic product is dealt with in the cell so as to protect it from the disruptive agencies *which exist there. Arrangements for this* purpose must be present since we know that substances may accumulate in cells which *contain enzymes that hydrolyse them.* For example, fat and lipase co-exist in the liver cell and also glycogen and amylase. The *phenomena of autolysis illustrate this same* fact too. Whatever these arrangements are they appear in certain instances to be closely associated with the *life of the cell,* for after death they cease to operate and the synthetic product is again broken down. However difficult it is to form a conception of them it may be necessary to do so since they must form a part of any system which is put forward to explain synthesis as a result of the intervention of surface phenomena.

We may now consider two syntheses in which there is little or no doubt about the raw materials or some of the chemical reactions involved. These are the production of glycogen and of proteins.

Glycogen was first isolated in 1857 by Claude Bernard and a little later was analysed by Kekulé, who showed that it had the empirical formula $C_6H_{10}O_5$. It is only recently that its probable structure has been determined. Last year, Haworth, Hirst and Webb succeeded in preparing trimethyl glycogen and proved that on hydrolysis it gives rise to 2.3.6. trimethyl glucose. This observation supported by similar work by Karrer indicates that glycogen is constituted like starch on the basis of continuous maltose units, or what amounts to the same thing, a conjugated chain of α-glucose units.

(*To be concluded*).

NEW ATOMIC THEORY.

Before the recent British Association at Bristol Dr. P. A. M. Dirac, a Fellow of St. John's College, Cambridge, who is not much over 30 years, caused some interest by the advancement of a novel theory on the electron and atom. His subsequent explanation of his theory was not over illuminating. It is (he said) believed that all matter is built up from the two elementary kinds of particles—the electron and the proton. Recent theoretical work seems to suggest that these two kinds of particles are not independent, and that actually there is only one fundamental kind of particle in nature. The quantum theory of the election combined with the principle of relativity shows that there must be states for the electron in which its kinetic energy is negative—and is less the faster the particle moves—in addition to the usual state in which the energy is positive.

To give a physical meaning to these negative-energy states we must assume that they are nearly all occupied by electrons with just one electron in each state in accordance with the exclusion principle. We can then interpret the unoccupied negative energy and also a positive charge.

There are certain difficulties in the theory which have not yet been removed. They are (1) the great difference in the masses of the proton and electron, and (2) the fact that the theory predicates that electrons and protons will annihilate one another at a rate which is much too great to be correct, These difficulties are perhaps due to the fact that the interaction between electrons has not yet been properly taken into account.

THE SEPARATION AND DETERMINATION OF GALLIUM.

II.—The Separation of Gallium and Aluminium from Each Other, and the Determination of These Elements.

By Sunao Ato.

Of various methods hitherto published for the separation of gallium from aluminium and the determination of these elements, the following ones may be of importance: (1) a method of precipitating gallium by potassium ferrocyanide and leaving aluminium in solution; (2) that of precipitating aluminium, and leaving gallium in solution by passing HCl gas into a mixture of ether and hydrochloric acid containing both elements; (3) that of extracting gallium in the form of chloride by means of ether; and (4) that of precipitating gallium with cupferron.

In the first place, the writer has compared the three kinds of processes described below to see which one is the best to precipitate aluminium and to leave gallium in solution: (I) A process of using a solution of acetylchloride in acetone; (II) that of saturating a mixture of acetone and hydrochloric acid with HCl gas; and (III) that of saturating a mixture of ether and hydrochloric acid with HCl gas.

Reagents.

(1) A solution of aluminium chloride: A precipitate made by adding ammonia to an aqueous solution of Kahlbaum's aluminium nitrate (zur Analyse) was dissolved in hydrochloric acid. Into a mixture of this solution and ether, HCl-gas was thoroughly passed, and the resulting crystalline precipitate consisting of $AlCl_3.6H_2O$ was dissolved in hydrochloric acid. From this solution aluminium was reprecipitated twice in the same manner as above. The aqueous solution of the precipitate finally obtained was employed throughout the experiments, after the concentration of Al in it was determined by weighing 10g out of it, precipitating Al as hydroxide, igniting and weighin it as Al_2O_3.

(2) A solution of gallium chloride: The same solution described in the previous report was employed.

(3) Some ordinary *acetyl chloride of Kahlbaum being found to contain* phosphorus of 0.002 per cent. of PO_4 in quantity, the same compound (zur Analyse) supplied by Kahlbaum was employed after it was tested for phosphorus. Acetone of the same

chemical works, Merck's ether (anhydrous, distilled over sodium), and ammonia, hydrochloric, nitric and acetic acids of Nippon Junyaku Kaisha were employed.

(4) A mixed reagent consisting of one part of acetyl chloride and four parts of acetone was used.

Process I by means of a solution of acetyl chloride in acetone.

A method for the separation of aluminium as a crystalline precipitate of $AlCl_3.6H_2O$ *from iron, and for the determination of the* former, by adding a solution of acetyl chloride in acetone to a solution containing chlorides of both elements, was reported by Minning. This method has been examined carefully by the present writer in the way described below with solutions containing chlorides of alumininm and gallium with a view to separating the elements from each other.

Experiment 1.—To confirm that gallium chloride, when present alone, is not precipitated by a *solution of acetyl* chloride in acetone, separate portions of gallium chloride solution containing 1.3 mg. 13.1 mg., 96.7 mg., and 198 mg., respectively, as gallium oxide, Ga_2O_3 were evaporated to dryness on a steam bath, and 20 cc. of the acetyl chloride-acetone solution were slowly added to each residue with constant stirring, no insoluble residue being observed. The solution was filtered, and the filter was washed with the same reagent, ignited and weighed, the absence of gallium being thus confirmed.

Experiment 2.—To see to what degree of perfection aluminium chloride is precipitated, when present alone, by the acetyl chloride-acetone solution, separate portions *of aluminium chloride* solution containing various quantities of aluminium were weighed out and evaporated on a steam bath almost to dryness, and 30 cc. of the acetyl chloride reagent were slowly added to each residue with constant stirring. The resulting precipitates were separately washed and filtered by decantation with 20-30 cc. of the same reagent, and dissolved in water. The aluminium was precipitated from the solutions by adding ammonium chloride and then ammonia to weak alkaline, and heating the *mixtures. The precipitates were fil*tered, washed to free them from chloride ion, ignited and weighed. The filtrates were evaporated, and the resulting residues were treated with nitric acid to oxidise a black substance in them, and ignited to remove any organic matter, and the final residues were converted into the chloride. From these solutions aluminium was precipitated and its quantities were determined in the manner described above, the following results being obtained:

Al taken mg	Al precipitated mg	Al in filtrates mg	Al found mg
1.3	1.1	0.2	1.3
15.6	15.6	0.1	15.7
128.0	128.1	0.15	128.25
767.0	—	0.2	—

The final residues, which were obtained from the filtrates and weighed as Al_2O_3, were converted into the chloride, and the presence of aluminium in the solution was confirmed by means of aluminion.

Experiment 3.—To see how exactly the two elements can be separated from each other, solutions containing various quantities of both elements as chlorides were prepared by weighing out each of the component solutions, and evaporated on a steam bath almost to dryness. To the residues were slowly added 30 cc. of the acetyl chloride reagent with constant stirring, and the resulting precipitates were washed and filtered by decantation with 20-30 cc. of *the same reagent. The quantities of alumin*ium present in the precipitate were determined in the same manner as in the last experiment. The filtrates containiug gallium were evaporated to dryness, and the residues were repeatedly evaporated with concentrated nitric acid to oxidise a black substance in the residue and to convert the chloride in the residue into nitrate, ignited and weighed as Ga_2O_3, the following results being obtained:

	Al and Ga together (in mg) as Al_2O_3	as Ga_2O_3	*Al found* in mg as Al_2O_3	Ga in filtrates in mg as Ga_2O_3
i	156.1	1.2	156.1	1.3
ii	156.1	23.8	135.9	23.9
iii	468.3	27.0	468.7	26.6
iv	780.5	27.1	—	26.4

The quantities of gallium found in the filtrates were smaller than those which hal been taken at the start, amounting to 0.4 mg in (iii) and 0.7 mg in)iv). This being considered to have been caused by the im*perfectness of washing in freeing $GaCl_3$ from* the precipitate of $AlCl_3.6H_2O$, the solutions of the precipitates in water were evaporated to dryness, and the residues were treated as before with the acetyl chloride reagent. Gallium was found to be present in the filtrates in quantities of 0.3

mg in (iii) and 0.5 mg in (iv). This result shows that when the precipitate of $AlCl_3.6H_2O$ is large it must be washed thoroughly with something more than 30 cc. of the acetyl chloride reagent.

Process II by saturating a mixture of acetone and hydrochloric acid with hydrogen chloride.

Since acetone is miscible with hydrochloric acid and less volatile than ether, this compound may be substituted for ether with some favourable effects in precipitating aluminium as $AlCl_3.6H_2O$ by the method of Gooch and Havens, in which hydrogen chloride gas is thoroughly passed into a mixture consisting of some ether and a solution of $AlCl_3$ in hydrochloric acid. With this consideration, the following experiments have been made :

Experiment 4.—To confirm how completely aluminium will precipitate when it is present alone, four portions of a standard aluminium chloride solution were weighed out and evaporated to dryness. Each residue was dissolved in a mixture consisting of 20 cc. each of 6*N* HCl and acetone, and the solution was saturated with hydrogen chloride in the ice-water cold. The resulting precipitate was washed and collected on a filter by decantation with a solution consisting of 20 cc. each of 6*N* HCl and acetone and saturated with HCl gas. The quantity of aluminium in the precipitate was determined in the same manner as in the experiment (1).

Al taken (mg)	Al precipitated (mg)	Al in filtrates (mg)	Total Al found (mg)
1.26	0.9	0.3	1.2
2.72	2.4	0.3	2.7
106.00	—	0.4	—
511.4	—	0.4	—

Experiment 5.—To see to what degree of perfection aluminium will be separated from gallium, various mixtures were made by weighing out the standard solutions of $AlCl_3$ and $GaCl_3$, and evaporated on a steam bath almost to dryness. Each of the residues was dissolved in a mixture of 20 cc. each of 6*N* HCl and acetone. The solution was saturated with HCl in the ice-water cold, and the quantity of aluminium in the resulting precipitate was determined in the same manner as in the experiment 4. The filtrate was evaporated to dryness. The residue was repeatedly evaporated with concentrated HNO_3, and then ignited and weighed as Ga_2O_3.

Al and Ga together (in mg) as Al_2O_3	as Ga_2O_3	Al in precipitates (in mg)	Quantities of Ga in filtrates (in mg)
1.72	27	1.4	27.3
156.1	27	155.7	27.5
468.3	27	369.0	26.1

Process III by saturating a mixture of ether and hydrochloric acid with hydrogen chloride.

A report on the separation of gallium from aluminium, by precipitating the latter by the method described by Gooch and Havens, and on the determination of gallium in the filtrate, was published by Dennis and Bridgman, who recognised a certain error in the results of the determination but offered no explanation about the error, which comes, in the present writer's view, from the incompleteness of the precipitation of aluminium. Experiments made by him with mixtures of the chlorides of aluminium and beryllium have shown that the complete separation of aluminium as $AlCl_3.6H_2O$ by the method of Gooch and Havens seems to be very difficult. The separation of the same element from gallium by the same method will probably be equally difficult in attaining to its completeness, but to confirm it the following experiments have been made :

Experiment 6.—A number of the standard solutions containing various quantities of aluminium were evaporated to dryness, and each residue was dissolved in 20 cc. 6*N* HCl. To the solution were added 30 cc. of ether, and hydrogen chloride gas was thoroughly passed into the mixture in the ice-water cold. The resulting precipitate was washed and transferred in a filter by using 50 cc. of a mixture of 6*N* HCl and ether saturated with HCl gas. Aluminium in the precipitate was determined in the same way as in the previous experiments. The residue obtained by evaporating the filtrate was treated in the same manner, and aluminium in it was determined, the following results being obtained :

Al taken (mg)	Al precipitated (mg)	Al in filtrates (mg)	Total Al found (mg)
1.3	1.2	0.1	1.3
2.6	2.4	0.2	2.6
11.3	11.2	0.2	11.4
115.7	115.4	0.2	115.6
255.7	255.3	0.3	255.6
511.4	—	0.4	—
560.0	—	0.7	—

Experiment 7.—*To see to what extent* aluminium is separated from gallium, solutions containing both elements in varying quantities as chlorides were evaporated almost to dryness. The residues were treated *just in the same way as in the last experiment*, and the ignited residues were weighed as Al_2O_3. The residues obtained by evaporating the filtrates from the precipitate of $AlCl_3.6H_2O$ were evaporated with concentrated HNO_3, by means of which they were perfectly converted into the nitrate, and the final residues were ignited and weighed as Ga_2O_3.

Al and Ga together (in mg) as Al_2O_3	as Ga_2O_3	Al in precipitates (in mg)	Ga in filtrates (in mg)
1.3	1.0	1.1	1.2
13.2	1.3	12.9	1.5
511.4	66.7	—	66.2

ADVANTAGES AND DRAWBACKS IN THE THREE PROCESSES.

(1) The separation of aluminium from gallium by the first process of precipitating the former as $AlCl_3.6H_2O$ can be made very easily and so satisfactorily that only a very small quantity of it remains in solution. But acetyl chloride containing no phosphorus compound is expensive and can be secured with difficulty. The determination of gallium in the filtrate is also attended with some trouble, for gallium chloride in the filtrate must be converted into nitrate which is to be ignited and weighed as Ga_2O_3. This conversion is made by evaporating the filtrate to dryness and by heating the dry residue with concentrated nitric acid. But the dry residue consists of gallium chloride and a black substance, which results from the decomposition of acetone, and the amount of which is always so large that it obscures the presence of gallium chloride. The gallium chloride in the residue can be converted into nitrate by evaporating the residue with concentrated nitric acid from five to six times in case the quantity of Ga_2O_3 is less than 100 mg, but the completion of the conversion can be estimated with difficulty.

(2) By the second process aluminium is not precipitated completely, and a certain quantity of it remains always with all of gallium in the filtrate, so that the determination of gallium from the filtrate gives too high a value. In this process also, a large amount of the black substance results from acetone as in the first process.

(3) By the third process, also, aluminium is not precipitated completely, and when gallium is determined from the filtrate in the same manner as in the first method, the result will be too high. The filtrate, however, can be evaporated very easily, and only the chloride of gallium together with that of a small quantity of aluminium remains in the residue. This makes the separation of the latter from the former very convenient in the method described below.

(4) Aluminium can be precipitated completely by none of the three methods as has been mentioned above. And when much liquid is used for washing the precipitate of $AlCl_3.6H_2O$ to free it from the chloride of gallium, some aluminium may enter into the washings. The separation of gallium from such a small quantity of aluminium as in the united solution of the filtrate and washings just described can be made satisfactorily by means of camphoric acid which precipitates gallium completely in a solution of 0.6 *N* acetic acid leaving aluminium in solution when the latter is present in a small quantity.

The Institute of Chemical and Physical Research, Tokyo, Japan.

SEVENTY YEARS AGO.

"THE CHEMICAL NEWS."

No. 2, VOL. I, DECEMBER 17, 1859.

Among the contents will be found :—

"Why do Ships Rot."

"On the Oxides of Iron, as a Means of Conveying the Oxygen of the Air to Combustible Matters." By F. Kuhlmann.

"Isomeric Alkalides." By C. Greville Williams.

"The Analysis of Platiuum Ores." By M. M. Deville and H. Debray.

"On the Production of the Purple Rose-Red Murexide Colours in Cotton Printing." By Dr. Von Kurrer.

"Modern Application of Chemistry.—Chinorine — The Extraction of Potato Starch."

"Modern Theories of Chemical Notation."

"Specific Group of Vapours at Very High Temperatures."

"On the Octahedric Oligist of Vesuvius."

"Detection and Estimation of Small Quantities of Lead in the Presence of Other Metals."

[A limited number of single copies can be had—Address, Manager, *Chemical News*. Mark envelopes, "Back Numbers."]

PULVERISED FUEL FIRING FOR INDUSTRY.

Some Details of a Striking Plant in Belfast.

In 1925 the steam and boiler plant of the York Street Flax Spinning Co., Ltd., of Belfast, a famous textile firm, was completely re-organised and some detailed information has now been made available on the subject, particularly interesting as showing that the latest principles of pulverised fuel firing are applicable to the average industrial plant.

Essentially 18 "Lancashire" boilers, 2 vertical boilers, cast iron economisers, various old main engines, and over 8000 feet of shafting, including 83 pairs of large bevel wheels and 5 vertical shafts, were replaced by one water tube boiler of 35,000—40,000 lbs. evaporation per hour, operated with "Lopulco" pulverised fuel, a pass-out turbine of 2250 K.W. giving 2000 lbs. of steam at 15-30 lbs. pressure, and electric driving for the different groups of shafting. The result has been not only a great economy in coal but a much more uniform driving throughout the mill, with increased production and less noise and vibration, while the whole installation has run 4½ years without the slightest trouble.

The contract for the boiler plant, together with the buildings, was awarded to International Combustion Ltd., of London, and the coal is taken by a vertical chain bucket elevator of raw coal bunkers, two in number above the boiler, having a total capacity of 180 tons. From here the coal passes to a vertical, rotary, steam-heated "Lopulco" drier with a capacity of 4 tons of coal per hour, reducing the moisture to 3 per cent. the design being essentially a series of horizontal, hollow, cast iron plates, steam heated attached to a central rotary hollow spindle, while there is circulated through the drier hot flue gases from the economiser outlet at the rate of 6000 cubic feet of air per minute at 300°F. the gases being charged to the chimney.

The pulveriser is of the "Ramond" 4-roll type, with a capacity of 4 ton of coal per hour, driven by a 50 H.P. motor running at 400 revolutions per minute, giving 85 per cent. through a 100 mesh screen and 100 per cent. through a 40 mesh screen, with the usual arrangement of a constant air current for gravity separation of the particles and a cyclone separator. Also the pulverised coal bunker has a capacity of 20 tons and the boiler is fired by 4 "Lopulco" burners of the fan-tail type pointing downwards in the combustion chamber, 3725 cubic feet in volume above the ash-pit, while 15 per cent. of the total air for combustion passes through the feeders, and the remaining 85 per cent. direct into the combustion chamber fitted with water screen of 171 square feet heating surface.

The boiler is of the "Babcock and Wilcox" longitudinal cross-drum design with three drums, 9272 square feet heating surface, working at 250 lbs. pressure with a normal evaporation of 35,000 lbs of steam per hour and 40,000 lbs overload, having also inter-deck superheater of 2732 square feet heating surface, giving 200°F. superheat and an all-steel cased economiser of 3185 square feet, the feed water entering at 110°F. and leaving at 200-220°F. with an exit temperature of the flue gases of 310-320°F. In the earlier days of running, figures of 87.3-88.0 per cent. boiler plant efficiency was obtained with an evaporation of 35,000-41,000 lbs. per hour, using coal with a heating value of 12.014 B.Th.U. per lb. Afterwards, however, much cheaper coal was substituted of 10,800-11,300 B.Th.U., resulting in a further saving.

Finally it should be stated that the turbine is of the "Fraser and Chalmers" impulse, multi-stage, pass-out type, direct coupled to a G.E.C. turbo-alternator, while the condenser is of the "Hick-Hargreaves" make, 3100 square feet cooling surface, and taking at 27.75″ vacuum, 152,400 gallons of water per hour at 78° F.

ROYAL PHOTOGRAPHIC SOCIETY.

There are well over 1,000 exhibits at the 75th Annual International Photographic Exhibition this year at 35, Russell Square, W.C. The pictorial section comprises 215 photographs by 172 exhibitors and these have been selected from the work of no less than 520 photographers who submitted prints for exhibition. Almost every civilised country is represented in this section. The collection will afterwards be shown in various provincial centres and in Canada and U.S.A., so that the influence of high-class work will be spread over a wide area.

An interesting collection of photographs of natural history subjects, many in natural colours is also on view, as well as a series of wonderful spark photographs.

An exhibit of importance, from the Ilford Research Laboratories, shows (1) the structure of emulsions, (2) the colour sensitiveness of emulsions, (3) structural differentiation by X-rays, and (4) haze elimination.

Collections of colour transparencies are also on view.

GENERAL NOTES

BIG METEORITES.

It is reported that a mass of meteoric iron weighing 299lbs., one of a pile of several tons, collected from the desert in the neighbourhood of Gibeon in Great Namaqualand, on which a terrific meteoric shower once fell, probably in prehistoric times, has been received by the Natural History Museum from the Administration of South West Africa.

These masses of meteoric iron in Great Namaqualand were first heard of about a century ago. Natives have used fragments from them for their weapons, just as the Eskimos have been found to do from others that have fallen in North Greenland.

Within the last ten years a far larger mass has been known in Damaraland, about 400 miles north of Gibeon. This, the gigantic "Hoba" meteorite, still reposes on Hoba West farm 12 miles west of Grootfontein, at the end of the railway, in South West Africa. A dozen people can walk round on its level surface, and estimates of its weight range from 50 to 70 tons. The largest meteoric in the Natural History Museum weighs about 3½ tons, It was found in 1854 at Cranbourne, near Melbourne.

As late as the eighteenth century, Dr. Spencer recalled, the fall of iron and stones from the sky was regarded with incredulity But on December 13, 1795, a meteorite weighing 56lb., now preserved in the Museum collection, was seen to fall at Wold Cottage, near Scarborough. Others, in the museum collection, fell at Ashdon, in Essex (1923), at Appley Bridge, Lancashire (1914) in County Antrim (1902), in Gloucestershire (1835), and in Oxfordshire (1830).

The number of stones which fall at any one time and place is usually small, but occasionally there have been some very remarkable showers. On January 30, 1868, about 100,000 stones, varying in weight from 20 grains to 20lb., fell near Pultusk, in Poland, being distributed over an area of about five square miles, and on July 19th, 1912, 14,000, though some were no larger than grape seeds, fell in Arizona.

There is apparently no record of loss of life or injury during these meteoric showers. The narrowest escape was that of three children who were sleeping in a bedroom near Braunau, in Bohemia, when one of the two masses of iron which fell there in July, 1847, went through the roof and covered them with debris.

STEEL STRUCTURES RESEARCH CONFERENCE.

The Department of Scientific and Industrial Research announce that a Conference on Steel Structures Research will be held in the Lecture Theatre of the Institution of Civil Engineers at 11 a.m. on October 16.

The purpose of the Conference is to promote discussion of the work and objects of the Steel Structures Research Committee of the Department. This Committee has been set up to review existing regulations for the use of structural steel in buildings and bridges, and to investigate the possibilities of more efficient and economical design. In order to ensure the effective application of the results of the Committee's work, it is felt to be desirable at an early stage to enlist the interest and co-operation of various bodies concerned. The Conference will, therefore, provide an opportunity for an exchange of views and for a consideration of various suggestions that have been made, in particular the feasibility of formulating a standard practice in the use of structural steel in building throughout the United Kingdom.

Invitations have been addressed to local authorities, professional and technical organisations concerned. Any bodies who have not received invitations and who would wish to be presented at the Conference are requested to communicate with the Secretary, Department of Scientific and Industrial Research, 16, Old Queen Street, Westminster, London, S.W.1.

INTERNATIONAL DIPLOMA FOR BRITISH FIRM.

The extraordinary manner in which Great Britain caters for the needs of overseas markets could not be better instanced than by the award just announced to Messrs. E. H. Bentall of Maldon Essex (one of the associate firms of Messrs. Agricultural and General Engineers, Ltd.), of the Diploma of Honour at the Antwerp Exhibition for Coffee Plantations machinery. This is the highest honour for coffee machinery given by this international exhibition and yet it has been won by a British firm. Machinery for coffee plantations is of a highly specialised type, while coffee is not grown anywhere in the British Isles and only in a few parts of the Empire. The fact, therefore, that a British firm can beat foreign rivals in such a specialised branch of engineering is another tribute to the efficiency of the agricultural engineering industry :

ALBERTA NATURAL GAS FOR SASKATCHEWAN CITIES.

PROPOSALS FOR PIPE LINE CONSTRUCTION.

Proposals similar to those recently made to the city authorities at Regina, Moose Jaw and Swift Current, have now been received by the Saskatoon City Council, both from the Dominion Gas and Electric Company and the Northern Utilities Company of New York, relative to the supply of natural gas from Alberta Wells.

The project put forward by the Dominion Gas and Electric Company forms part of a scheme designed to include the four cities named, and it was intimated that the offer might have to be revised if the proposals were accepted by only one of the cities in question. The cost of building the complete pipe line system would reach about $17,000,000.

The offer from the Northern Utilities Company of New York, however, provided for a supply to Saskatoon irrespective of the decision which might be arrived at by the other cities named, and the rates quoted would be the same in each case. The rates quoted by the Northern Utilities Company of New York start at 80 cents per 1,000 cubic feet for the first 5,000 cubic feet of gas used per month. From this figure the price decreases to 55 cents where more than 50,000 cubic feet of gas are used per month. The commercial or industrial rate starts at 50 cents for the first 100,000 cubic feet and decreases to 20 cents where very large quantities are taken. The rates submitted by the Dominion Gas and Electric Company start at 75 cents per 1,000 cubic feet for the first 4,000 cubic feet of gas used per month, going down to 25 cents for all amounts over 5,000,000 cubic feet of gas nsed each month.

A MARKET FOR BRITISH GOODS IN SPAIN.

British exports to Spain increased substantially in 1929 and reached a higher actual value than in any year since 1921. It would appear that when allowance is made for the changes in the prices of United Kingdom exports the volume of exports to Spain last year was well above that of any post-war year and only a little below the volume of exports in 1913.

IRISH FREE STATE TRADE PROGRESSING.

The latest Irish Free State Trade figures show a decided turn for the better. For the twelve months ended July 31st the adverse balance of trade has fallen to £8,894,404 in comparison with the corresponding trade last year. Imports for the twelve months amount to £59,617,772 and exports plus re-exports £49,022,906.

The total volume of trade has increased from £107,822,862 to £108,640,780. This improvement is due largely to the progress of the Fordson Traction factory in Cork, the exports from which in all came to £2,239,000.

DYESTUFFS (IMPORT REGULATION) ACT, 1920.

The following statement relating to applications for licences under the Dyestuffs (Import Regulation) Act, 1920, made during August has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee.

The total number of applications received during the month was 488, of which 424 were from merchants or importers. To these should be added 13 cases outstanding on the 31st July, 1930, making a total for the month of 501. These were dealt with as follows :—

Granted—450 (of which 482 were dealt with within 7 days of receipt).

Referred to British makers of similar products—23 (of which 22 were dealt with within 7 days of receipt).

Outstanding on 30th August—28.

Of the total of 501 applications received, 454 or 91 per cent. were dealt with within 7 days of receipt.

WHOLESALE PRICES IN AUGUST.

As measured at the Board of Trade, wholesale prices in August showed, on balance, a decline of 1.1 per cent., as compared with July, and a decline of 13.3 per cent., as compared with August, 1929, the index numbers for the three months being 70.9, 71.7 and 81.8 respectively (1924 = 100).

The index number for all articles for the month of August (70.9) records a still further movement in the downward trend of wholesale prices, which has continued, month by month, since October, 1929, the aggregate decline in that period amounting to 18.4 per cent.; food prices have fallen by 18.0 per cent., and prices of industrial materials by 18.8 per cent.

OLIVE OIL FOR MOTOR-CARS.

Attempts are being made in Spain to popularise the use of native olive oil as a lubricant for motor-cars and internal combustion engines.

Many technical difficulties have been overcome. The chemical processes involved in converting the edible product into a suitable lubricant result in a loss of about 30 per cent. in weight, but it has been found that a satisfactory oil can be produced at a cost to the public which is approximately that of imported American mineral lubricating oils.

Spain like Britain spends millions every year on imported lubricating oil and it is anticipated that any attempt to establish a home industry will be met by a reduction of prices on the part of the big interests controlling the foreign product. Such a threat would be met either by a tariff or by an appeal to olive-growers to accept lower prices from patriotic motives, in order to set a vastly important new home industry on its feet.

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NOTICES OF BOOKS.

Handbuch der Schwefelsaurefabrikation By DR. BRUNO WAESER. Vol. I. Pp. xxviii + 848; Vol. II, pp. viii and 849—1426; Vol. III, pp. viii and 1427—2036. Brunswick: F. Vieweg and Son. 1930. Price 195 marks.

The heavy chemical industry is indebted to Dr. Bruno Waeser for his careful revision and elaborate extension of the 4th (German) edition of Lunge's Handbook on the Manufacture of Sulphuric acid upon which the present comprehensive and exhaustive work has been based.

Stabilised as were the working processes of the manufacture of oil of vitriol and allied products before the war, that intensive period and the decade succeeding it have witnessed many striking advances. This has rendered the need for a more modern treatise on the industry all the more pressing and the task of producing a standard and up-to-date work on the subject has been admirably carried out by Dr. Waeser.

The first volume deals exhustively with the manufacture of Sulphur Dioxide and the 2nd is concerned with the conversion of this gas into Sulphuric Acid in the lead chambers and absorption towers, whilst the third volume describes the Contact Process for the manufacture of sulphuric acid. A long list of recent technical books has been compiled and from them the author has drawn; the periodical literature of pure and applied chemistry has been thoroughly searched and the Patent Specifications of every manufacturing state having a direct bearing on the subject has been studied. If anything the author has erred rather on the side of including too much in the way of minute details of earlier processes although it must be admitted that he lays due emphasis on recent developments and the current practice.

After a short historical sketch an account is given of the various raw materials available as sources of sulphur. These include crude mineral sulphur, recovered sulphur from industrial and other gases, pyrites and metal sulphides, sulphites and sulphates. Tre respective treatment and statistics of production both of the ores and the final products are quoted in extenso and reference is made to by-products and to those substances of no industrial value but which are produced from time to time, either accidentally or for academic interest.

The second volume includes a detailed account of the construction of the lead cham-

bers and the absorption towers in the classical method of manufacturing Oil of Vitriol. Works practice and exact conditions for securing maximum results are discussed and the various complicated reactions which can occur are considered from both the theoretical and practical standpoints. The process of purification and concentration also receive full treatment.

Perhaps the most significant of the three volumes is the last which covers the Contact Processes for making Sulphur Trioxide and Sulphuric Acid. Here the difficulties encountered by the early investigators are reviewed in the light of present knowledge and the help derived from theoretical sources are sketched in a striking manner.

Not the least valuable section of the third volume is the collection of statistics covering the production of sulphuric acid in all countries for periods over which records are available.

Dr. Waeser has devoted 20 years to the Sulphuric Acid Industry and has made full use of his knowledge and experience in compiling the present comprehensive Handbuch which will be the standard treatise on the subject for many years to come.

Forthcoming Events.

THE ROYAL INSTITUTE OF PUBLIC HEALTH.

37, Russell Square, London, W.C.1.

THE HARBEN LECTURES, 1930.

These Lectures will be delivered in the Lecture Theatre of the Institute by Prof. William H. Park, M.D., LL.D., D.Sc. (Director of the Bureau of Laboratories, Health Department, New York City), on "Pneumonia." as follows :—

Monday, October 6, at 4 p.m.—"The Types of Pneumococci in Adults and Children and their Significance."

Tuesday, October 7, at 4 p.m.—"The Epidemiology. The Refining of Antipneumococcus Serum."

Wednesday, October 8, at 4 p.m.—"The Therapeutic Use of Vaccines and Antibacterial Sera."

LECTURES ON TROPICAL HYGIENE.

The Secretary of the London School of Hygiene and tropical Medicine (University of London) announces that the next series of lectures and demonstrations on Tropical Hygiene, which are intended for men and woment outside the medical profession proceeding to the tropics, will be given by Lieut.-Col. G. E. F. Stammers, O.B.E., M.R.C.S., L.R.C.P., D.P.H., on October 8, 9, 10, 13, 14, 15, 16 and 17, from 11 a.m. to 12.30 p.m. Syllabuses and full particulars can be obtained on application to the Secretary, London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, W. C.1.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

26,766.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of derivatives of the 1.2-benzanthraquinone series. Sept. 8.

26,884.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of hydroxy alkyl amines. Sept. 9.

27,078.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of azo-dyestuffs. Sept. 10.

Specifications Published.

315,312.—I. G. Farbenindustrie Akt.-Ges. —Process for the manufacture of condensation products from diolefines and hydrocarbons.

334,692.—I. G. Farbenindustrie Akt.-Ges. —Manufacture and production of anthraquinone carboxylic acids.

Printed copies of the full Published Specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2., at the uniform price of 1s. each.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

GARDINOL.

514,729.—Chemical substances for use in the dyeing industry. — H. Th. Bohme Aktiengesellschaft, 29, Moritzstrasse, Chemnitz, Saxony, Germany. September 17.

ZEROSEL.

514,915.—Chemical substances, being compounds for the removal of hardness and iron compounds from water, and salt included in class 1 for use in regenerating such substances.—United Water Softeners, Ltd., Aldwych House, London, W.C.2. Sept. 17. (Associated.)

DEGLATOL.

514,726.—Chemical substances for use as desizing materials in the textile industry.—H. Th. Bohme Aktiengesellschaft, 29, Moritzstrasse, Chemnitz, Saxony, Germany. Sept. 17.

FOR SALE.
FIRST SIX VOLUMES OF "THE CHEMICAL NEWS."

Vol. 1—Dec., 1859, to June, 1860.
Vol. 2—June to Dec., 1860.
Vol. 3—January to June, 1861.
Vol. 4—July to December, 1861.
Vol. 5—January to June, 1862.
Vol. 6—July to December, 1862.

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BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

BRISTOL, 1930.

SECTION I.—PHYSIOLOGY.

THE SYNTHETIC ACTIVITIES OF THE CELL.

By PROF. H. S. RAPER, C.B.E., F.R.S.,
President of the Section.

(*Concluded from p.* 214.)

It has also been proved that when glycogen breaks down in the liver it gives rise to glucose. Lohmann and also Barbour have succeeded in obtaining glycerol extracts of liver and muscle which hydrolyse it, but the product appears to be a trisaccharide and not glucose. No enzyme which by itself hydrolyses glycogen to glucose has yet been obtained from animal tissues. It is of interest that pancreatic and salivary amylase produce isomaltose from glycogen. These results suggest that there may be some configural difference between glycogen and starch which accounts for their difference in behaviour with diastatic enzymes. Be that as it may, it appears natural to assume that the synthesis of glycogen in the cell is brought about by the simple reversal of a hydrolysis which may be catalysed by enzymes under appropriate conditions. These conditions have, however, not yet been realised *in vitro.* The much simpler synthesis by enzyme action of disaccharides from hexoses—the first example being that of isomaltose from glucose by Croft Hill—has so far been seldom achieved. Barbour in the experiment just referred to was unable to demonstrate any synthesis of glycogen from the trisaccharide produced by the muscle enzyme even in highly concentrated solutions.

This failure to obtain evidence of the synthesis of glycogen from the products of its hydrolysis makes it legitimate to consider whether we are right in adopting the orthodox view that the synthesis of glycogen from glucose in the living cell is brought about by a reversal of action of the enzyme or enzymes which hydrolyse it.

Besides the facts about the constitution of glycogen and the nature of its hydrolytic products that have already been mentioned, there are others which merit consideration in any discussion of its mode of synthesis in the body. When an animal is fed liberally with glucose or fructose it converts a part of them into glycogen in the

liver. The evidence for this is indubitable. It implies, therefore, either a conversion of fructose into glucose before the condensation to glycogen occurs or a conversion of both into some common form of hexose which then undergoes the condensation. Further, there is a considerable amount of accredited evidence that many substances not belonging to the sugar group can be converted into glucose in the animal body. Such substances therefore, must be regarded as potential glycogen formers. Several amino-acids such as alanine, glutamic acid, aspartic acid, gylcine and serine come into this category. Then it is well known that glycogen can be formed from the trioses glyceric aldehyde and dihydroxyacetone as well as from methyl glyoxal and lactic acid, which are easily derived from them *in vitro*. In addition, glycerol and glycoladehyde can give rise to glucose in the diabetic animal though the evidence in favour of the latter is not very convincing. It is easy to understand from the work of Emil Fischer on the synthesis of hexoses from glycerose how glycerol and the two trioses could give rise to a hexose in the body. It is also possible that methyl glyoxal by condensation and hydration could be converted into a hexose and that lactic acid, which has been shown by Dakin and Dudley to be capable of conversion into methyl glyoxal *in vitro*, could also undergo the same change. But the production of glucose from amino-acids is not explicable so easily except in the case of alanine and perhaps aspartic acid, and we must assume that in the process of catabolism which they undergo intermediate substances are produced which can condense to a hexose. Our knowledge of the metabolic changes which the amino-acids undergo suffices in some instances to offer a reasonable explanation of this on chemical grounds, but not in all. Whatever these processes may be which eventually result in the production of a hexose from such diverse substances, the most remarkable thing about them to my mind is that the hexose is always *d*-glucose. We have no satisfactory explanation for this striking stereochemical performance, but the facts suggest two possibilities. Either the condensation of the two—or three—carbon units to a hexose is brought about under such specific conditions of strain that only the *d*-glucose configuration can result, much as coins must be minted in a definite mould to become currency, or the hexose produced by these various condensations is a labile form which condenses to glycogen and is in turn hydrolysed to glucose. But to produce this hypothetical labile form of hexose or to bring about its condensation to glycogen would probably require such conditions of specificity that this second hypothesis seems unnecessary.

The view that any substance that produces glucose in the body may also give rise to glycogen is supported by good experimental evidence. Several of the glucose-formers that have been already mentioned are able to produce glycogen in the isolated, perfused liver, particularly in the liver of the tortoise. But the difficulties of this kind of experiment are considerable and the conditions for success are not completely understood. It is, however, essential that the liver cells be alive and adequately supplied with oxygen. It has also been demonstrated that insulin plays some part in enabling this synthesis to be brought about; but exactly how it enters into the process is not known.

Much more exact studies of the synthesis of glycogen in the animal cell than are possible with liver have been made with frog's muscle. Fletcher and Hopkins, in their well-known experiments on the production of lactic acid by muscle, showed that in undamaged muscle and in the presence of oxygen the lactic acid which is produced during the contraction process disappears. Meyerhof proved later that the disappearing lactic acid was largely reconverted into glycogen. Assuming that the oxygen which is necessary for this process is used in oxidising a part of the lactic acid, we get the relation that of four part of lactic acid produced in the muscle one is oxidised and three are utilised for the resynthesis of glycogen. Under more ideal experimental conditions and using thermal data, Hartree and Hill calculated that the ratio of lactic acid resynthesised to lactic acid oxidised is about four to one. The chemical mechanism of this synthesis is unknown. Under conditions in which muscle produces glycogen from lactic acid, Meyerhof was unable to observe such a synthesis from a series of substances including, among others, glyceric acid, glyceric aldehyde, dihydroxyacetone, alanine, glycolic acid, glycolaldehyde and acetaldehyde. The only substance discovered to behave like lactic acid was pyruvic acid, and Meyerhof has expressed the view that this is due to its preliminary reduction to lactic acid. We have thus no

evidence of the intermediate substances between lactic acid and glycogen in this synthesis. On the other hand, we have the very positive evdence that it occurs only in the presence of oxygen. Although this suggests that a coupled reaction is concerned involving the utilisation for synthesis of energy provided by oxidation, no satisfactory picture of an oxidative reaction of lactic acid which would result in the production of glycogen, water and carbon dioxide has been put forward.

A consideration of all the data which have been accumulated regarding the synthesis of glycogen makes it probable that more than the mere reversal of enzyme action is concerned. It is certain that the cells in which it occurs must be supplied with oxygen. Fletcher and Hopkins also showed with muscle that its structure must be maintained and with liver the synthesis certainly only takes place in the intact organ. Do not these facts point to the conclusion that it is only the living cell that can bring about this synthesis? And if this be so, cannot we go further and suggest that the substances from which glycogen are produced or bodies derived from them must first become bound up with, or at some stage form an integral part of the living structure before they are converted into glycogen. The evidence at least suggests that some such conception of the processes may not be far from the truth.

We may now pass to the consideration of the synthesis of proteins. In the early part of this century, due largely to the elegant methods introduced by Emil Fischer, rapid advances were made in our knowledge of the structure of proteins. These advances led to a picture of protein structure which has become generally accepted, namely, that the protein molecule is formed by the union of amino-acids through an amide linkage. It is, however, unlikely that this is the only bond of union between the amino-acid units. If it were, the widely different physical and chemical properties which are met with in the proteins would have to be explained largely on the basis of their amino-acid content. The differences in composition which they exhibit do not seem to be sufficiently great to warrant this assumption. The insolubility of the keratins for instance, although accounted for in part by the high proportion of cystine they contain, this being a very insoluble amino-acid is possibly also due to the presence of other modes of union of the constituent amino-acids in addition to the amide linkage. Similarly, the varying degree of liability, the phenomena of denaturation, and the physicochemical behaviour of different proteins are difficult to explain solely on a basis of differences in their components. There is much therefore still to be learnt about the actual structure of the protein molecule.

The investigation of the structure of proteins which are closely allied in origin, composition and general chemical behaviour by immunological and in part by chemical methods, has taught us how intricate the mechanism must be by which they are built up. The facts brought out by the classical work of Dakin and Dale on the albumen of the duck's and hen's eggs serve to exemplify this. The only chemical difference that could be shown between these two proteins was concerned with the disposition in the molecule of some of the leucine, aspartic acid and histidine, which resulted in different degrees of racemisation of these amino-acids when the respective albumens were treated with caustic soda.

But when used as antigens in the anaphylactic reaction they were markedly specific. These results indicate that the stereochemical structure of the molecule is different in proteins which are very similar both in general chemical properties and in biological origin. They suggest that the protein molecule produced by a particular type of cell is always built up in a distinctive and, so far as we can determine, an unvarying pattern. We may deduce from this that although the general method of protein synthesis, that is to say, the mechanism by which amino-acids are joined up, may be the same in all cells, yet there must be arrangements in the cell which enable only one particular, final pattern, to result from the synthesis.

What are the methods by which the amino-acids are caused to combine? Those used by the organic chemist in the synthesis of polypeptides can have no place in the living cell although they have been of great assistance in helping to reveal the general structure of proteins. The use of proteolytic enzymes in an attempt to bring about synthesis under conditions which have been partially successful with other substances has often been tried and nearly as often failed. Two examples of protein synthesis by enzyme action have been described. The most acceptable of these is Taylor's production of a protamine by a glycerol extract of clam liver from the products of its complete hydrolysis.

But, so far as I am aware, this is an isolated observation which has not been extended or repeated with other protamines. The other is the preparation of so-called plasteins from the products of the partial hydrolysis of certain proteins by pepsin. A comprehensive review of the subject of plastein formation by Wasteneys and Borsook, who have themselves made notable contributions to this problem, has led them to the belief that in this phenomenon we have a true resynthesis of protein from some of the more complex of its hydrolytic products. Apparently only certain of these yield plastein on treatment in highly concentrated solution with pepsin under appropriate conditions, and the distinctive feature in them which makes plastein formation possible has not yet been discovered. It seems probable that it is both a property of certain proteoses and of pepsin that enables the synthesis to occur, and some evidence for this view is provided by the observation of Wasteneys and Borsook that the formation of bodies similar to plastein is brought about when benzene and some other substances are emulsified in a peptic digest of egg albumen. The plasteins obtained in this way have different physical properties from those obtained by the action of pepsin on similar digests. Wasteneys and Borsook suggest that this may indicate how differences in composition of the proteins synthesised by the organism are produced, certain proteose substrates being specifically adsorbed on particular surfaces in the cell and then undergoing reaction to form the synthetic product. Even if this be accepted as a possible explanation it still leaves many questions regarding protein synthesis unanswered and not the least difficult of these is the problem of how the separate amino-acids are brought together to form the specific proteose substrates which one must postulate as combining—and in a definite order—to produce the particular protein which is characteristic of the cell which synthesises it.

One of the great difficulties in accounting for the synthesis of protein by a reversal of enzyme action is that this synthesis only takes place, so far as we can observe, in a cell which is living.

The process by which the substance of the cell is increased, the building up of protoplasm, is one which must be closely allied to protein synthesis, since the material we call protoplasm is constituted for the greater part of amino-acids, united, so far as can be ascertained, by the same sort of linkage that we find in proteins. The protoplasm of the dead cell responds to all the tests by which we identify protein, it is subject to the action of hydrolytic agents in the same way and yields identical products when hydrolysed.

Ought we not therefore to look for some of the mechanisms of protein synthesis in the processes which operate when the living cell grows, and can we by any stretch of imagination account for this by a reversal of the action of one or more hydrolytic enzymes?

It appears inconceivably difficult to do so. The extreme specificity of the reaction which necessitates that at a given phase of the synthesis one particular amino-acid and that alone can be added as the next link in the molecule, requires such a multiplicity of enzymes and such a remarkable degree of control of their action as to be almost outside the range of probability. When we remember, however, that one of the prime attributes of life is that it is a dynamic condition, it does become possible to form a conception of protein synthesis in relation to that fact. The experiments of Willstätter and others have shown that to some extent the specificity of enzymes is accounted for by the 'carrier' with which they are associated. It is not inconceivable that a catalyst capable of bringing about the union of amino-acids in the living cell and ultimately fashioning its protoplasm may be attached to or associated with a 'carrier' which, instead of having a fixed configuration, as with the enzymes that we can extract from the dead cell, has one which is continually varying, this dynamic state being characteristic of the living material of the cell.

If, further, we could assume that the variations in the configuration of the carrier were cyclic, always going through a definite series of phases, it might be possible to account for the fact that at any particular phase of the cycle the configuration would be such as to favour the synthetic union of one particular amino-acid rather than any other because of its spatial arrangement. The assumption of cyclic changes in simple or complex living organisms is not new in Physiology, and it is not unlikely that they occur in parts even of the cell itself. The phenomena of mitosis are a somewhat gross illustration of such cyclic events.

It is perhaps difficult to justify speculations of this kind, but it appears to me that it is at least useful as an intellectual exercise to try and arrive at some conception, founded on what little experimental evidence we at present possess, of a possible mechanism which would account for the reproduction time after time of the intricate pattern of the protein of a particular type of cell.

Whatever be the mechanism of protein synthesis there is another fact concerning it which is of interest, and that is that the cell to maintain itself must apparently contain a certain concentration of amino-acids. If these are not supplied in the animal's food then the animal supplies them by maintaining its more important tissues at the expense of others. This would suggest that the conditions for nitrogeneous equilibrium which we find in the whole animal have their replica in each cell, but the concentration of amino-acids required to maintain the equilibrium is not the same for all. Hence an amino-acid deficiency such as occurs in protein starvation leads to autolysis of some tissues before others. The equilibrium conditions appear to be set at different levels. The fact that certain amino-acids are more necessary than others in providing for this balance may be partly due to their special importance in the protoplasm of those cells which are the first to break down when protein food is withdrawn or an inadequate protein is fed.

The possibility that protein synthesis is associated with some part of the cell which is undergoing cyclic changes, and is thus alive, raises the interesting question of the site of this and possibly other syntheses, such as those of fat and glycogen. Are all parts of the cell, that is to say, both nucleus and protoplasm, to be regarded as alive in the sense I have indicated, and therefore to be considered as regions in which syntheses depending on life can be brought about?

It is necessary not to confuse the terms irritability and life. It is true that what we term irritability is usually taken to imply that the tissue which shows it is living, but taking the nerve fibre as an example, it would appear that the maintenance, for a time at least, of the irritability of protoplasm and its restoration when it has disappeared—but not irreversibly—does not require the presence of the nucleus. It may require oxygen or the presence of certain ions, but this may merely mean that the labile state of the protoplasm has been upset by the products of the cell's activity, and removal of these will restore it to its irritable condition.

We have no evidence that irritability as a manifestation of what we call life is more than the possession of extremely labile structures, sensitive to minute environmental changes. The nucleus, on the other hand, is essential to the continuous life of the cell and its growth. It appears also to determine very largely the magnitude of the respiratory processes which occur in it at rest, though not necessarily the excessive respiration observed in the recovery from functional activity. Can we therefore go so far as to say that the nucleus is the seat of those synthetic activities of the cell which appear to depend on its living character rather than on its irritability, or have we to regard the protoplasm as equally living so that it is able to reproduce itself and in addition bring about such syntheses as those of fat and glycogen?

There is something to be said in favour of the idea that the protoplasm is not living in the sense in which the nucleus is, and therefore is less likely to be the seat of certain synthetic processes. It is, I think, quite a tenable view that protoplasm is made up, largely but not entirely of combinations of amino-acids such as we find in the proteins, and that it is synthesised by the nucleus to serve special as well as certain general requirements. These special requirements must and do vary greatly with each type of cell.

Consider the mammalian erythroblast. The principal substance in its protoplasm is the protein hæmoglobin. It is doubtful whether this cell exists except to produce hæmoglobin. When it has matured the nucleus degenerates and disappears leaving the red corpuscle. Along with the respiratory activity of the cell practically disappears too, and there is not much discoverable in it except hæmoglobin. It is certainly now not living in the sense in which its progenitor, the erythroblast, was. Is it not reasonable to suggest, therefore, that the production of hæmoglobin is the erythroblast grows and matures is a function of the nucleus and not of the protoplasm of this cell? All semblance of further synthesis of hæmoglobin certainly disappears when the nucleus goes. The adoption of such a view does not imply that having

produced the protoplasm of a cell the nucleus has nothing more to do with it. We know that in some indefinable way the nucleus in most cells controls the structure of the protoplasm and maintains its lability, but we have no knowledge as yet of the mechanism by which this is brought about.

In emphasising the great similarity between the growth of protoplasm and the synthesis of proteins, other examples in addition to that of hæmoglobin come to mind. The cells of the Malpighian layer of the epidermis have to produce the protein which eventually becomes the keratin of the *stratum corneum.* This would appear to be one of their chief functions. When it is done the cell dies and the nucleus becomes functionless. The production of collagen by cells of the connective tissue and of milk proteins by the cells of the mammary gland are instances of the continuous synthesis of proteins which are not labile like the protoplasm of, say, the muscle or nerve cell. Their formation, however, may be due to the operation of the same general process. They are certainly non-irritable and non-living. It is difficult to imagine that while in the cell they possess the power of reproduction but lose it once they have been cast out.

If we accept the possibility that the nucleus of the cell may be the site of protein synthesis it is legitimate to consider whether the substances which appear in the protoplasm as discrete particles or masses such as glycogen or fat are produced in the nucleus or only in the protoplasm. We have no evidence as to this. The fact that they first appear as visible objects in the protoplasm is not evidence that they were produced there, and it has already been pointed out that their synthesis is apparently only possible in cells which are alive. They may be synthesised in the nucleus and stored in the protoplasm. Their disappearance from time to time may be conditioned by the liberation of enzymes from the nucleus to hydrolyse them. Such a view would do away with some of the difficulties which we experience in attempting to explain why substrates may be present in cells which, judged by their behaviour after death, appear to contain enzymes that hydrolyse them. The protoplasm, instead of producing such reserve materials, may serve as a convenient storehouse for them until the appropriate stimulus for their breakdown arrives.

One property of proteins, which may account in a general way for the presence of protein-like structure in protoplasms, is their buffering power. The nucleus is probably the most labile part of the cell. The chemical reactions proceeding in it may demand an environment that has to be finely controlled as regards changes in reaction or the concentration of certain ions. The protoplasm may thus serve as a protective layer between the nucleus and the external world, guarding it from changes which would otherwise terminate its existence. The known properties of the proteins, both chemical and physical, may be useful to this end, to which they are almost ideally suited.

Even if we can accept as possible the unorthodox view that the nucleus is the only living part of the cell, and is therefore the only part that can bring about syntheses which depend upon life, it does not solve our difficulties in explaining how they are achieved. It merely narrows down the possible sites in the cell in which they occur. The nucleus itself is a complex structure, and we have as yet few experimental methods for elucidating it. Most biologists would, I think, agree that the cell has arisen by a process of evolution from something simpler and eventually from non-living materials. It cannot have come as a 'bolt from the blue.' If we regard the nucleus as the only living part of the cell, then we may justly regard the protoplasm as something that has been acquired or developed in the process of evolution and is now necessary to its existence. We do not know definitely, however, of nuclear material which is living and devoid of its protoplasmic envelope unless such an arrangement is present in the bacteria. But the investigation of filterable viruses has given an indication that material possessing the prime attribute of life, namely, the power of reproducing itself, exists, possibly in simpler forms than we find in the smallest visible organisms.

If we agree that the cell has evolved from something simpler, then we might expect to find such elementary forms of life coexisting with it did we but know how to look for them. The filterable viruses may represent such forms, and their chemical characters may resemble those that we find in the nucleus of the cell. The ability to synthesise protein may be a property which living material only acquired at a late stage of its

evolution, and that property may be one which in the process of time has come to be essential for the maintenance of the complex structure of the nucleus as we see it to day.

I have dwelt for a time on these problems of synthesis in relation to the structure of the cell because, however speculative they appear to be in the present state of knowledge, it seems to me that it is necessary to get some picture of them. Progress in synthetic chemistry has been intimately associated with the ability to represent objectively the structure of substances and the changes which take place when they are undergoing reaction. We know much about the manifold chemical activities of the cell, but, until we can by deductive methods get some picture of its organisation, the problems which I have attempted to sketch briefly in this address will not be solved.

The view has sometimes been expressed that it is the task of physiology to study the reactions of the whole animal because the whole animal is the unit. That is perfectly true if our object be only to describe and account for animal behaviour. But there is just as truly a cellular physiology in which the cell is the unit. Until we can analyse and understand the behaviour of the cell we cannot expect fully to explain the reactions of the whole animal.

In stressing therefore the importance of studying the activities of the cell as such for the progress of our science, I feel that I am not at variance with some of my predecessors in this office. Like them, I have attempted to indicate the lines upon which progress may come in our endeavour to elucidate some of the problems to which I have referred.

Classical organic chemistry with all its achievements of synthesis cannot yet claim to rival the synthetic activities of the cell. That it will ever do so as regards the synthesis of our main foodstuffs, the proteins, carbohydrates and fats, cannot be foreseen. Both from the chemical and economic points of view the signs at present are not very hopeful. The synthetic breakfast table is a myth and likely to remain one. Man has, so far, not learnt from Nature the mechanisms of synthesis that she uses and on which his existence depends, so that the tilling of the soil and reaping of the harvest must for long remain his most vitally important occupation.

DYES AND TEXTILES IN BRITAIN: 1930.

By James Morton, LL.D., F.R.S.E.

(Chairman, Morton Sundour Fabrics, Ltd., Carlisle; Chairman, Standfast Dyers and Printers, Ltd., Lancaster; Chairman, Scottish Dyes, Ltd., Grangemouth; Director, British Dyestuffs Corporation, Ltd.)

Paper read at the Meeting of the British Association at Bristol.

When Professor Morgan, this year's President of the Chemical Section of the British Association, approached me for a paper, I explained to him that I had recently delivered myself at such length to the Royal Society of Arts on the particular aspect of Dyes with which I am familiar—in a paper called "The History of the Development of Fast Dyeing and Dyes"—that I felt I had not much more to add. He explained, however, that as I occupied the unique position of being both a dyemaker and a large user of dyes, my opinion at this time would be of special value as helping to strike a balance between the interests of the makers and the users of dyes, particularly in relation to the incidence of the Dyestuff Act, which ends its normal course in January next. Perhaps I ought to explain that, while I remain chairman of Scottish Dyes, and a director of British Dyestuff Corporation, my financial interest in dyes is now mainly merged in Imperial Chemical Industries, so that, speaking financially, I am only a 1 per cent. maker of dyes and 99 per cent. a user.

It will not be expected of me at this time to go into details of processes or enlarge on the technical side, as I understand others will be speaking mainly on these interesting aspects, and the purpose of my appearance here will, perhaps best be served by asking and trying to answer a few broad questions on the general situation, questions such as these.

Does the position of the dyemaking industry to-day justify the very special efforts and the hopes of ten to twelve years ago, and may it now be ranked as a permanent and valuable asset to the productive industries of this country? Has it, up to the present, been of value or otherwise to dye-users here, and have the special provisions under which it has had to be developed been in any sense responsible for our widespread textile depression What part has the Dye-

stuffs Act played in the development of the industry, and is it in the best interests of the country, and the users of dyes in particular, that the Act should now lapse or be continued in the same or a similar form.

First, as to the comparative condition of dyemaking in this country to-day and in 1914. The earlier story is too well known to need restating. While in 1914 we were the greatest textile country in the world, with the largest export trade, we had practically no sound independent dyemaking industry, for although considerable bulk of ordinary dyes was produced, we were mainly dependent on imports for our intermediates, the manufacture of Alizarine being the outstanding exception. So that, although we had a very large and flourishing dyeing industry, it was practically a spoon-fed one, depending for its supplies and its processing mainly on Germany and her chemists.

In the Royal College of Chemistry in London, for some ten years previous to 1865, Hofmann, with his pupil Perkin and others, had been patiently unearthing the new values to be had from crude bodies of coal tar, and had obtained Aniline and the first synthetic colouring matter. Yet our textile people and dyers, though, as I have said, they were making millions every year, failed to grasp the potentialities of the discoveries or to give them any support. It was left to Germany, a country then poor in comparison with ourselves, to realise the meaning of these new things, so that in 1865 they beckoned Hofmann and his collaborators back to Berlin to continue that great work initiated in London—work that has helped, indeed has made, modern Germany, and ultimately resulted in this country being dependent on her for the most vital part of our textile industries.

Two simple examples will serve to indicate how immediate and far-reaching this development was. The two main dyestuffs in use were Madder and Indigo, both from natural plants. The area occupied in the growth of Madder in 1868 was something like 400,000 acres. The colouring matter of Madder is Alizarine, and within ten years of the discovery of this synthetic production exceeded what had been that of the natural product, and by 1908 the total synthetic Alizarine production was considerably over twice that of the original natural Madder, and users got their supplies at less than one third the price of ten years before. The amount produced would have required 1,000,000 acres for its growth, and the saving effected to dye-users in the various countries was over £4,000,000 a year. This was developed to some extent in this country but to a much larger extent in Germany.

Synthetic Indigo followed, and makes an even more striking story. It was developed entirely by the new school of chemistry in Germany. We had in India some 1,300,000 acres growing Indigo plant, yielding some 22,000 tons a year of what is now know as our standard 20 per cent. Indigo paste, valued at about £4,000,000 and employing, it is said some 6,000,000 people. By 1913, Germany was producing 34,000 tons of the same strength indigo. The Indian trade was reduced to very meagre dimensions, and the buyer got his Indigo at less than one-third the price of the former natural product. So that by a small group of chemists and a few hundred people in Germany there was replaced a great and ancient industry largely under British control in India.

I have emphasised this because we must take it fully into our reckoning in gauging the progress of the dyemaking industry here from that time till now. It had to be built up almost from the foundation, and, so far as the more complex colours were concerned, entirely from the foundation. It is difficult to realise what all this has meant unless viewed from the actual inside workings of the dye factory. Users see only the finished product, but know nothing of all the processes that have had to be experimented on and perfected before that colour can be presented to them. Even chemists in other branches of the chemical trade scarcely realise the complexity of the processes of the dyestuffs industry. In many of our colours, for example, there are 6 to 12 intermediate stages, and the chemistry of even one of these intermediates is probably more complicated than some other chemical product made on the large scale which may form the sole or main product of a heavy chemical factory. In Scottish Dyes we now make and market practically 100 separate colours and over 200 intermediates. Most of these colours, as I have said, have to pass through 6 to 12 , even 14 intermediate stages, and the number of alternatives at each stage, on a conservative estimate, would average three; so that the combination of possible routes to a colour is very large indeed, and it requires extensive knowledge and research before the best way of making even one colour is arrived at. This complexity in the chemis-

try and manufacture of dyestuffs is common in a greater or lesser degree to all branches of the trade, and is a factor, especially in relation to time, that should never be lost sight of in estimating the progress of dye-making.

But in spite of all these obstacles, what has been the record of the industry, and has it to any extent justified the early hopes? What would Lord Moulton think of the growth of his child? The plainest statement is perhaps the most eloquent that could be made. In 1913, we made some 9,000,000 lbs. of dyestuffs, largely from intermediates imported, and, therefore, only partially British-made. This represented fully 20 per cent. of our consumption. In 1929, we made 55,785,032 lbs. almost exclusively from our own intermediates, representing over 90 per cent. of our consumption. In 1913, we had not made a single one of the complex Vat colours. In 1929 (apart from Indigo), we made 2,639,000 lbs. of these dyestuffs, including every one of the many necessary intermediates.

During the boom period around 1920, when textile manufacturers made profits in millions, it was entirely home dyes that made this possible: there was no other source available. The benefits accruing to the textile trade from these two periods, in my opinion, made a tremendous offset balance in favour of the home dye service.

But what of the subsequent years, especially since 1922, when Reparations stopped and the operations of the Dyestuffs Act have token normal effect? There is a general impression that during those years the dyestuffs industry has been living on sufferance under shelter of the Act, and at a great sacrifice on the part of the users. We are discussing just now not the Dyestuffs Act itself, but whether the users have benefited or otherwise by the existence of a dyestuffs industry in this country. What would have been the experience of users supposing the dye industry here had suddenly ceased, say, in 1922? Should we be having cheaper colours to-day in consequence? Have we anything to guide us in that respect? Remember I am assuming a condition in which practically no colour would be available from makers here, and the foreign makers left with no check whatever on the prices they might charge. The only test we can take, and it is surely a fair and sound test, is to ask what has been the basis of their charges to us in the colours that we did not make, and where they have had in consequence a free and unchecked field.

In retrospect of these last ten years, therefore, while there have been difficulties and some hardships to face on the part of the users, in giving to the makers in this country time for their processes to mature, I am sure the bulk of the users will agree on balance it has been enormously to their gain to have the services of a home dye industry.

As the idea persists, however, among an aggressive minority that the industry has been fostered at great sacrifice by the users, and that it has been a distinct factor in the continued depression of the textile trade, I should like to suggest one or two broad tests on this very important point. If the lack of dyes or high prices have been a serious obstacle, this should be reflected in the returns of those branches of the trade dependent mainly on their dyes content, as distinct from other branches not dependent on dyes. We find the recent report of the Government Cotton Inquiry most valuable and illuminating in this respect. It analyses and tabulates the export returns of the various sections of the textile trade, and these are the figures. In Grey, unbleached cloth (using no dyes) the exports decreased from 2,357,492 thousand linear yards in 1913 to 944,823 in 1929. In Bleached cloth (also with no dyes) the decrease was from 2,045,252 thousand yards in 1913 to 1,288,273 in 1929. Printed goods (partially coloured only) decreased from 1,280,754 thousand yards in 1913 to 551,706 in 1929; while dyed and dyed-yarn goods (wholly coloured) decreased only from 1,441,754 thousand yards in 1913 to 970,049 in 1929. Indeed the sterling value of the dyed goods showed an actual increase in the period, the figures being £26,569,000 in 1913 against £33,914,000 in 1929.

Dyemaking is essentially a trade that carries very heavy overhead charges in respect of research chemists, process chemists, and special engineers. It is a trade where a high minimum production is essential not only in gross but in individual products if they are to be made economically. It is imperative that makers here should retain *all* the trade the country can give in colours that they can make equally with the makers abroad. If markets were free, there would be an inevitable dividing of our orders among home and foreign makers. The foreign makers get practically the entire trade of their own country, and unless makers here are assured of the bulk afforded

by the home market, their production could never reach the necessary economic standard. It should be made clear that we mean to remain in the dye industry in all its branches, and bulk trade in established colours is the only way of enabling us to carry such overheads as will make further research and advance possible.

Lastly, and what I regard as most important of all. It is essential for the future of the industrial existence of this country that we should have the largest possible body of young men with training such as is derived from a thorough grounding in organic chemistry. It is the fibre we most need throughout the whole texture of our industries. Dyes is the natural training ground, but the value and influence of a large body of experienced organic chemists such as this industry gives would be felt by and would flow over to other branches, and to none more so than to textiles. It is precisely the kind of qualities developed by chemists of a dye industry that are most needed for the problems of the textile industry, witness the artificial silk trade, and the advantages that would accrue from the contact and collaboration of groups of such men on the problems of these two allied and interdependent industries is greater than can be imagined. That is something I can already testify from personal experience, and it would be a bad day for textiles if they took any step that would in the slightest degree retard the growth of an accumulating experience and knowledge of organic chemistry and its personnel in this country. It is even worth much temporary sacrifice, if sacrifice there would be.

Such are some of the main reasons in my opinion for doing nothing at this time to disturb the happy balancing conditions presently afforded by the Dyestuffs Act: the opinion of one who is not only keenly interested in dyemaking, but even more involved in textiles and the use of dyes.

It may be asked, then, would I suggest a simple continuance of the conditions of the existing Act with no modifications at all. I have searched round for what might be better conditions to meet the desired objective, and frankly I cannot find them. It has been suggested by Sir Henry Sutcliffe Smith that a safeguarding tariff might be imposed on certain agreed-upon colours now made in this country, with a free entry to all other colours. I scarcely think that this arrangement would be better for either party, the maker or user, than is afforded by the existing conditions. As users, we are already getting such agreed-on colours at, say, the average price of similar colours on the Continent of Europe. To put a duty on such colours might result in prices being raised here to the extent of the duty, no small matter on probably 90 per cent. of our supplies, when we already get them at competitive prices, and with no duty. By the Act, the whole of the trade in these colours would be secured to the home makers so long as they could supply at, say, the average European price. Sir Henry further suggested that all colours, other than such agreed-on colours, should come in free. But already all dyes not made here come in free under the present Act, and would continue to do so till they could be supplied from makers here of equal quality at competitive prices. If the new suggestion means that a line is to be drawn now at the existing stage of development, and no further special consideration given beyond colours that are now made, then it would be a serious blow to progress in dyemaking here, and would have the effect of more or less stereotyping the industry at its present stage of development. The present accommodation of allowing colours in free till they can be adequately made by the home producers is surely sounder and meets the situation better. It may be argued that foreign makers will not continue to send their new products just to accommodate us till we are ready, but the field of new products is so vast, and they have so stupendous a handicap, that there would always be sufficient bulk trade here in these newer things to justify their catering for our market. Also it must not be forgotten that any new foreign products that are patented have the protection of our Patent Laws, and would have access as they could not be produced here except under licence.

One new provision, I should like to suggest, might be added to any modified form of the Dyestuffs Act. It is that new colours from abroad that are practical equivalents of colours already made here, should not be given licences for import. It has been very apparent that in many cases foreign makers have made new brands of existing types with the distinct object of evading the provisions of the Act, and getting trade in them as new dyes. Where any new colour has a distinct new property that would be of value our dyeing trade, we should obviously ...ve it, but where it is a practical equiva...t sent to evade our regulations it should ... ruled out. As I have already said, it ...ould be made abundantly clear that we

mean to continue in all departments of the dye trade, and for that purpose it is essential that the home dyemakers should have as a basis of their bulk production the whole demands of the users at home in the colours, *and their practical equivalents* that they have perfected and can supply. It is the only basis on which they can afford to continue research and build the future of their industry.

THE RESONANCE (*B-A*) BAND SYSTEM OF THE HYDROGEN MOLECULE.

By Hugh H. Hyman.
Physical Laboratory, Union College.

Part I. Experimental Procedure. — A three metre focal length vacuum spectrograph, designed by Professor J. J. Hopfield, has been constructed at the University of California and used to photograph the extreme ultra-violet hydrogen band spectra. A description of the type of mounting and method used to focus the instrument is given. The greater dispersion and resolving power has made possible the measuring of additional lines. New tables of frequencies are given.

Part II. Lines in sixty-eight bands have been given quantum assignments.—On the basis of the old quantum theory the moment of inertia of the hydrogen in the normal (*A* level) state is found to be 0.4673×10^{-40} g cm^2 and the nuclear separation to be 0.7500×10^{-8} cm. In the first electronic excited state (*B* level) the moment of inertia is 1.4225×10^{-40} g cm^2 and the nuclear separation 1.308×10^{-8} cm. Comparison of the present results with those obtained by Richardson and Davidson in their study of bands found in the visible leaves no doubt but that the ultra-violet *B* state also is the lower state of the bands studied by them. This, then, verifies the assumption made by Birge and leads to the conclusion that the ionisation potential of H_2 must be 15.34 volts to within a few hundredths of a volt.

Bands connected with vibrational levels A_0 A_1 and A_2 are not observed. In order to obtain the best possible value of I_0, data from all available sources were correlated and averaged. Birge and Jeppesen calculated accurate values of B_0 and B_1, for the normal level, from Rasetti's data on the Raman effect of gaseous hydrogen. Values for B_1 by the two methods agree to one part in seven thousand but their value for B_0 is 0.27 per cent. higher than the value given by the present method. This discrepancy points to an irregularity in the moment of inertia of hydrogen in the $v=0$ state of the normal electronic level, as has been pointed out by Birge and Jeppesen.
—*Physical Review.*

ROYAL SOCIETY OF ARTS. COMPETITION OF INDUSTRIAL DESIGNS.

Special Competition for Designs in Beatl

A special section of the Society's Competition of Industrial Designs will be held in November next. Three first prizes of £100 each, three second prizes of £50 each, and three third prises of £25 each, will be offered for designs for articles to be manufactured in Beatl Ware. The competition is divided into three sub-sections : (a) Designs for Door Furniture, Electric Lighting Parts, and Bell Pushes; (b) Designs for Lavatory and Bathroom Equipment; and (c) Designs for New Uses for Beatl.

The competition is open to all, and in view of the substantial prizes and the novelty of the subjects, it is hoped that the number of candidates will be large.

Particulars of the competition can now be obtained on application to the Secretary, Royal Society of Arts, John Street, Adelphi, W.C.2.

CARBON-MONOXIDE DANGER.

An inquest was held at Rochdale on August 27th, on the body of Richard James Atkinson, 34, motor-lorry driver, of Pine-street, Nelson. While Atkinson's lorry was drawn up outside a mill at which he had called he was found in the driving cabin dead from asphyxia due to carbon-monoxide poisoning. No defect had been found in the lorry engine. Dr. Pooley, pathologist, stated that one way of getting carbon-monoxide poisoning was by inhaling the exhaust of an internal combustion engine. One part of carbon-monoxide to 1,000 part of air was sufficient to produce unconsciousness, and two to three parts produced death. It could not be smelt, and its first effect was to produce drowsiness. A verdict was returned of " Death from carbon monoxide poisoning."

FREEDOM OF KENDAL CONFERRED UPON SIR A. EDDINGTON.

On September 25th, the Freedom of Kendal was conferred upon Sir Arthur Stanley Eddington, the eminent astronomer.

In the words of the Mayor (Councillor N. F. Wilson) in handing to him the scroll recording the council's decision, "Kendal has determined that it will not leave recognition of its most distinguished son to a future generation." It was made clear at the T wn Hall that there is a sincere appre iation here of Sir Arthur Eddington's place in science, although he spent only the first two years of his life in his birthplace.

As was pointed out in an appreciation sent by Sir Oliver Lodge, Kendal is the town in which John Dalton was first assistant master of the Friend's School in Stramongate. There he began the scientific thinking which led to his enunciation of the atomic theory. At that same school Mr. Arthur Eddington, father of Sir A. S. Eddington, was headmaster in the year when his son was born. In that school, Sir Arthur to-day supposed, some microbe left by Dalton preserved its vigour for 90 years to infect his with Dalton's mania for "atom chasing," as he described his studies, a pursuit in which ever since Dalton's day "chemists, physicists, mathematician, and astronomers" had collaborated, and yet for all of them the atom was still as great a puzzle as ever.

The Ceremony.

Mr. H. C. Wilson of Kendal, then formally presented Sir Arthur Eddington to the Mayor. He said he would have felt quite incapable of discharging the task properly he had not an appreciation kindly written for the occasion by Sir Oliver Lodge. Sir Arthur Eddington, the appreciation read, had applied his penetrating mathematics to examining the interior of the stars. For instance, when the companion of Sirius was discovered it was an extremely faint object and was thought to be a planet, but its spectrum showed that it was a star at a very intense temperature. Eddington's explanation of its faintness was that though so massive it was very small in size, and accordingly its density had a value far beyond anything known on earth. Recently the star had been used to verify Einstein's theory by aid of the intense gravitation existing on its surface, and the result was entirely in accord with Eddington's anticipations. In addition Sir Arthur Eddington was known to the public as the interpreter of Einstein, whose work he had both assimilated and extended. Eddington's gift of popular exposition was of a very high order. His books and lectures might be treated as works of literature.

Tribute by Sir J. J. Thomson.

Sir J. J. Thomson, Master of Trinity College, Cambridge, in the course of a letter to the Mayor, recalled his early associations with Eddington at Owens College, Manchester, and at the same college at Cambridge. The letter added:—"I feel proud of Sir Arthur Eddington for the distinction he has conferred on two institutions to which I am much attached. Sir Arthur Eddington's contributions to science cover a wide range. He is prominent as an astronomer. He has been president of the Royal Astronomical Society, and is the successor of Adams and Airy in the Professorship of Astronomy at Cambridge. He is the greatest authority in England on that important, evasive, and difficult subject of relativity. He has, by his eloquence, clearness and literary power, persuaded multitudes of people in this country and America that they understand what relativity really means. He has, too, written important papers on the new quantum mechanics. He has in the last few years taken the whole universe—past, present, and future— as his province. Sir Arthur is one of those rare cases where great literary is combined with great scientific ability.'

Sir A. Eddington's Reply.

Sir Arthur Eddington, in reply to these tributes, said that what Kendal had done had given him more pleasure than he could find words to express. He felt like a comet that had gone away into the cold, outer regions and whose orbit now brought it back to the warmth and affection of Kendal. He was too young to take away any direct memories of Kendal, but traditions had been woven into his earliest memories. One could not but feel pleased that Kendal recognised scientific work as service of public importance, not in any material sense—for nothing that he had found out had, he believed, ever been turned to practical account—but perhaps in some fuller sense. Referring to Dalton, Sir Arthur Eddington said that in the great furnaces of the stars and in the solitudes of nebulae the atom was apt to betray things it would not disclose in the physical laboratory where the physicist put it under third degree methods. He was proud to be following in the path which was opened by Kendal's greatest scientist

MAN'S EVOLUTIONARY HISTORY.

Sir Arthur Keith's Opinion.

The ninth annual meeting of the International Federation of Eugenic Organisations was held on September 12.

Among the speakers was Sir Arthur Keith who said they had to consider what effect modern civilisation was producing upon the manhood and womanhood of their respective countries. Was the generation now growing up as fit in body and in mind as the generation which it would replace? Or was the evidence definite that deterioration had set in? If irrefutable evidence were produced that civilisation was tending to exchange ability for mediocrity, then they had to discover measures which would alter the rules under which they lived so that the process of deterioration might be arrested. He hoped that the forces which had raised man to his present status could be used to raise him still higher.

He said that he approached eugenics with the eye of the pre-historian. There had been only two chapters in man's evolutionary history. The first began with the emergence of humanity from a Pithecanthropoid stage and ended with such full-blown types of humanity as were found in Europe and in South Africa towards the end of the last ice-age. In that phase the progress of man was effected amidst natural surroundings. Then some 10,000 years ago man's evolution proceeded under new conditions—the conditions seen in cities. These conditions were no longer made by Nature but by man. In the first or natural phase the production of race was everything; in the second the production of race was sacrificed for the accumulation of wealth. In both phases humanity walked towards its fate with closed eyes. If eugenists had their way a new phase—a conscious phase—in the evolution of mankind would be initiated. If we found that the way we were living was leading us straight to physical and mental bankruptcy we could no longer afford to be mere pawns on the chessboard of evolution; we must take a hand in the game.

The chief difficulty before eugenists was human nature, which was dominated not by reason, but by passion, feeling, emotion, prejudice, and instinct. The possibilities of eugenic reform depended on the extent to which human nature could be rationalised. There were signs which led him to think that the times were favourable. The public of all countries was more willing to listen to eugenic proposals than at any previous period. The highest dignitaries of the Church were now seeking to open a way for the eugenist. They had removed the taboo which surrounded all that concerned the source of human fertility and the processes of reproduction. Sir Arthur Keith concluded by saying the Federation was fortunate in having to welcome it Major Leonard Darwin, the Nestor of English eugenists. Since his father published the "Origin of Species" 70 years had gone. That book had moved the world towards eugenic reform more than any other. Major Leonard Darwin had devoted the greater part of his life in seeking to make his father's theory a practical policy.

Dr. C. J. Bond spoke on "The Dangers of Racial Decay and the Remedy." He gave some facts which pointed to deterioration in our population. The examination of 2,500,000 men of military age in 1918, showed that only one-trird were fit and healthy. The loss of work from sickness among insured persons in England and Wales in 1928 amounted to 26,500,000 weeks. The first step for the remedy was a fuller ascertainment of the real position. This would require a national stock-taking of the mental and bodily qualities of our citizens in different social groups. The next step was to cease breeding from inferior, and to promote larger families among superior stocks. Sterilization duly safeguarded and wisely applied, in combination with segregation, must he said, be the method of the future in preventing procreation in the case of the defective, irresponsible and anti-social individuals, who largely composed the subnormal lowest social group.

A PROFESSOR'S ADVICE.

Professor Doremus (New York), was sent a specimen of coal to analyse and after making his investigations he received a deputation of those interested in the venture, all eagerly awaited the good news of untold fortune. "Gentlemen," he asked, "where does this coal come from?" He was told that it came from a hill near Boston. "Then," the Professor said, "my advice to you is that you should acquire the hill at any cost, fence it round, and preserve it for ever for yourselves and your descendants, for when the great day of wrath comes, whatever else burns, this coal won't."

GENERAL NOTES

MARKET FOR DISINFECTANTS, INSECTICIDES, AND ANIMAL DRESSINGS IN CZECHOSLOVAKIA.

A confidential report on the market for disinfectants, insecticides and animal dressings in Czechoslovakia has been prepared by the Department of Overseas Trade from information furnished by the Commercial Secretary, His Majesty's Legation, Prague and issued to firms whose names are entered on its Special Register.

Firms desirous of receiving a copy of this report together with particulars of the Special Register service of information and form of application for registration should communicate with the Department of Over-Trade, 35, Old Queen Street, London, S.W.1. Reference Number B.X. 6789 should be quoted.

THE BRITISH CHEMICAL INDUSTRY.

The F. B. I. organ thinks there seems to be indications that an increase in trade will occur in the near future. The improvement in the heavy chemicals section has been maintained, although business is still below normal. Acetic acid, anhydrous ammonia, and sodium bicarbonate and bichromate have been in steady demand, and there were increased orders for copper sulphate for export. Very little business has been reported in coal tar products, with the exception of solvent naphtha and good grade creosote oil.

Pharmaceutical preparations show a tendency for easier prices and the market is very quiet. However, continued enquiries were received for aspirin, and there was a moderate trade in salicylic acid. Essential oils have shown considerable fluctuatious in price.

IMPROVED EDUCATION FACILITIES AT TORONTO UNIVERSITY.

According to a recent announcement by the Hon. Dr. H. J. Cody, Chairman of the Board of Governors of the University of Toronto, funds are to be provided by the Ontario Department of Mines for Mining Department in the University. The "Mill" building now occupied by the Mining Engineering Department will be converted into a three-storey structure four times the size of the present space for a main mining laboratory as well as iron ore, cyanide flotation and assaying laboratories.

Proceedings and Notices of Societies

THE CHEMICAL SOCIETY OF JAPAN.

Papers communicated :—

"Sinomenine. XVIII. Constitution of Sinacutin (*l*-Tetrahydro*epi*berberin)." By Kakuji Goto, Hideo Suzuki and Zenjiro Kitasato.

"Chemical Studies on Ancient Chinese Coins. I." By Tsurumatsu Dono.

"Constitution of Wogonin. II. The Synthesis of Wogonin Dimethyl Ether." By Shizuo Hattori.

"Biochemical Studies on 'Natsumikan,' *Citrus Aurantium*, L." By Shigeru Komatsu Shozo Tanaka, Shinosaku Ozawa, Ryoichi Kubo, Yuzo Ono and Zitsuo Matsuda.

"Sesquiterpenes. I. Sesquiterpenes and Sesquiterpene Alcohols in Camphor Oil from Formosa." By Shigeru Komatsu, Harusue Fujimoto and Shozo Tanaka.

Sesquiterpenes. II. Sesquiterpenes and Sesquiterpene Alcohols in the Cedar Oil from Province Tosa (Southern Part of Shikoku Island). By Sakujiro Kimura and Mamoru Mizoshita.

"Shereochemical Studies on Hydronaphthalenes. II. Catalytic Oxidation and Reduction of Hydronaphthalenes and Sesquiterpenes." By Sakupiro Kimura.

NOTICES OF BOOKS.

Constitution et Thermochimie des Molécules. Par ALBERT et MARCEL GOSSELIN. Pp. 231. Paris : Les Presses Universitaires. 1930.

Starting with the older theories of valency the authors have traced the applications of modern knowledge concerning atomic structure to organic chemistry. The quadrivalency of carbon was so simple a starting point in organic chemistry that despite its subsequent limitations it must not be lightly discarded. Werner's co-ordination theory and modern tendencies have introduced the question of atomic structure into consideration of molecular arrangements in organic compounds and the authors find that some of these receive support from the heats of formation of these compounds. This has also led them to suggest new formulæ for certain types of compounds and opens up a number of new problems.

M. Camille Matignon has contributed a preface to this important work in which he expresses the hope that the authors' views will stimulate further researches in organic chemistry.

Report on Welded Containers. London: H.M. Stationery Office. Price 1s. 3d. net.

The Department of Scientific and Industrial Research announces the publication of the Report of the Committee on Welded Containers. The Report deals with the construction, etc., of welded vessels for the storage and transport, in the liquefied state, of chlorine, sulphur dioxide, phosgene and liquid ammonia. It discussed the conditions to be observed in the welding operations, the steel of which the containers should be made, the design of the containers and "filling ratios," and the methods of testing the vessels. Two appendices are attached to the Report. In the first the results of rough handling tests, to which a number of welded vessels of different types were subjected by the railway companies, are described. In the second the results of the subsequent examination of the vessels at the National Physical Laboratory are given.

Forthcoming Events.

THE PHYSICAL SOCIETY.

The first meeting of the Physical Society will be held at the Imperial College of Science, Imperial Institute Road, South Kensington, on October 17, at 5 p.m.

ROYAL MICROSCOPICAL SOCIETY.

B.M.A. House, Tavistock Square, W.C.1.

The opening meeting of the session will be held in the Hastings Hall at the Society's new premises, B.M.A. House, Tavistock Square, W.C.1., on Wednesday, 15 October, at 5 for 5.30 p.m.

5 p.m.—The President and Mrs. R. Ruggles Gates will hold an informal Reception.

5.30 p.m.—Mr. J. E. Barnard, F.R.S. will demonstrate by Micro-Projection some Histological Preparations from the Society's Collection.

6 p.m.—Dr. G. M. Findlay, O.B.E., will communicate some recent research on Malarial Parasites.

The Biological Section will meet in the Pillar Hall at the above address on Wednesday, 5 November, 1930. Hon. Secretary: Mr. D. J. Scourfield, I.S.O., F.L.S., F.Z.S.,

THE INSTITUTE OF METALS.

NORTH EAST COAST LOCAL SECTION.

In the Electrical Engineering Lecture Theatre, Armstrong College, Newcastle-on-Tyne, at 7.30, Chairman's address. By Mr. C. Cresty.

SHEFFIELD LOCAL SECTION.

In the non-ferrous section of the Applied Science Department of the University, St. Georges Square, at 7-30 p.m. Conjoint Meeting for the sixth "Sorby" lecture.

OIL AND COLOUR CHEMISTS' ASSOCIATION.

Manchester Section.

A Meeting of the above Association will be held at the Milton Hall, Deansgate, Manchester, on October 10, at 7 p.m., and the Committee will be pleased to welcome any guest at this meeting.

The following paper will be read:—

"Some Possibilities of Inorganic Paint Vehicles." By Nöel Heaton, B.Sc., President of the Association.

SOCIETY OF GLASS TECHNOLOGISTS.

The first meeting of the Society of Glass Technology for the Session 1930-31, will be held in the The Peak Buildings, Terrace Road, Buxton, on Wednesday, September 17th, 1930, at 2.00 p.m.

PROGRAMME.

2.00 p.m. A. Minutes. B. Applications for Membership. C. Announcements.

2.15 p.m. D. General Discussion on "The Use of Borax in Glass Manufacture." Subject to be opened by Edward Meigh, Esq., M.B.E., M.Sc.

3.15 p.m. E. General Discussion on "Glass Technology and Industrial Progress" Subject to be opened by Professor W. E. S. Turner.

THE ROYAL INSTITUTE OF PUBLIC HEALTH.

A course of lectures on "The Prevention of Accidents, Disorders and Disease" will be held in the Lecture Hall of the Institute, 37 Russell Square, London, W.C.1.

Wednesday, October 15th, at 4 p.m. The Prevention Accidents, Disorders and Disease in Members of the Medical and Nursing Professions. By E. Graham Little, M.D., F.R.C.P., M.P. Physican in charge of the Skin Dept., St. Mary's Hospital.

New Patents.

These particulars of New Patents of interest to Readers have been selected from *the Official Journal of Patents*, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

27,581.—(I. G. Farbenindustrie Akt.-Ges.).—Manufacture of organic compounds containing nitrogen. Sept. 15.

27,663.—(I. G. Farbenindustrie Akt.-Ges.).—Manufacture of products containing nitrogen. Sept. 16.

Specifications Published.

313,493.—I. G. Farbenindustrie Akt.-Ges.—Process for the manufacture of indigoid vat dyestuffs.

Abstract Published.

332,911.—Quinoline derivatives. (I. G. Farbenindustrie Akt.-Ges.; Frankfort-on Main, Germany).

2 : 4-*Dioxyquinoline compounds* are prepared by condensing aromatic amines with malonic esters in organic solvents boiling above 170° C., the alcohol formed being preferably distilled off during the reaction. An excess of the malonic ester itself may be used as the solvent, provided it is present in at least twice the amount theoretically required. Examples are given of the condensation of (1) *a*-naphthylamine with malonic acid diethyl ester, in the presence of nitrobenzene or of an excess of the malonic ester, to give 2 : 4-dioxy-*a*-naphthoquinoline (2 : 4-diketo-1 : 2 : 3 : 4-tetrahydro-a-naphthoquinoline); (2) *m*-toluidine with malonic acid diethyl ester in the presence of nitrobenzene to form a 2 : 4-dioxyquinoline methylated in the benzene ring.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

ELIZABETH ARDEN.

505,689.—Deodorisers.—Elizabeth Arden, Ltd., 25, Old Bond Street, London, W.1. Sept. 24th. (Associated).

GRAMMAR OF LOGIC.

100 Questions and Answers on The Grammar of Logic or *How to Reason Correctly*. By J. E. ROSCOE, M.A., Oxon.

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BRICK KILN PATENT FOR DISPOSAL.

Mr. V. Lastovicka, of the Japan and China Trading Co., 56, Rasin Embankment, Prague, Czechoslovakia, is open to receive offers for the exploitation of his patented "Tunnel" Brick Kiln Construction in Great Britain and Dominions and Colonies.

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NOTICE TO AUTHORS & CORRESPONDENTS

Contributions for publication either as original articles or in the correspondence columns are welcomed by the Editor of *The Chemical News*.

They must be accompanied by the contributors' full names and addresses, not necessarily for publication, but as an indication of good faith. If a reply is needed or if it is desired that a manuscript which is not accepted for publication be returned, a stamped addressed envelope should be enclosed.

No notice can be taken of anonymous letters.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

SECTION M.—AGRICULTURE.

VETERINARY SCIENCE AND AGRICULTURE.

By P. J. DU TOIT, B.A., Dr. Phil., Dr. Med. Vet., *President of the Section.*

The mere fact that I have travelled more than 6,000 miles to come and deliver this address here to-day, is perhaps sufficient excuse for me to make a few personal remarks before embarking on the task which I have set myself. When I received the cable from the Secretary of the British Association stating that the Council invited me to become President of Section M for this year, the feeling of bewilderment which I experienced was only partly dispelled by the feeling of deep gratitude for the great honour that had befallen me.

A year ago this Association met in South Africa and many of you then had an opportunity of getting aquainted with the country, its problems and its people. Agriculturally you saw a country which is rapidly discarding the patriarchal and primitive methods of yesterday for the scientific methods of to-day. You saw our many problems and the necessity of applying all available scientific knowledge to their solution. You saw a people anxious to learn from the old parent countries in Europe or the countries across the Atlantic. Our thirst for knowledge was partly satisfied by your last visit last year, and I wish to give you the assurance now that that visit has been of inestimable and lasting value to South Africa in that it stimulated unprecendented interest in scientific work and scientific workers.

Not the least among the problems which you saw were those connected with *stock farming*. It is doubtful whether any country in the world has more problems confronting the stock owner than South Africa. Most of the stock diseases present in European countries are also to be found in the temperate climate of South Africa and, in addition, the majority of the diseases of tropical Africa thrive within its borders.

It is perhaps for this reason that Veterinary Science has made such rapid strides in South Africa. The need for scientific research was first brought home to farmer and statesman alike when rinderpest invaded South Africa 35 years ago and killed off almost the entire cattle population; and the

ravages of Horsesickness, Bluetongue, Heartwater, Nagana and scores of other diseases further emphasised the necessity of *scientific research*. *Fortunately for South* Africa (and perhaps for Veterinary Science) the right men were forthcoming to undertake this research and to-day, although many problems still await solution, the position of the stock-owner in South Africa is by no means hopeless.

The prominent position which Veterinary Research occupies in the scientific life of South Africa to-day, and the valuable practical results which have been obtained in this field of work, have encouraged me to choose as the subject of my address: the rôle which Veterinary Science plays in the *agricultural development of a country*. For obvious reasons my remarks will be confined almost exclusively to the Live Stock side of Agriculture in the wider sense. And for equally obvious reasons most of my examples will be quoted from South Africa.

In his brilliant presidential address to this Section in 1928, Dr. J. S. Gordon directed attention to the supreme importance of the live stock industry in the agricultural economy of every unit of the British Commonwealth of Nations. He came to the conclusion that the best means to improve this industry was the increased use of pedigree sires and the elimination of scrub bulls. He also emphasised the need for further research along the following lines: (1) Animal Nutrition, (2) Animal Diseases, (3) Animal Breeding, and (4) Marketing. Now all these subjects, with the possible exception of Marketing, fall within the scope of the veterinarian, and I shall attempt to show how modern veterinary science is actually advancing knowledge along each of these lines.

During the earlier half of the nineteenth century very little progress was recorded in Science. In regard to the origin of disease much ignorance and superstition prevailed. The 'miasmastic theory' was called upon to explain the spread of epidemic and epizootic diseases. Indeed, it seemed as if little progress had been made since the fourth century after Christ when the Greek writer, Chiron, maitained that glanders and similar diseases were caused by the 'pestiferous hot southerly wind from Africa.'

However, great strides were made during the latter half of the nineteenth century. The work of Louis Pasteur and Robert Koch cleared up the ætiology of some of the most [illegible] diseases. And the later veterinarian, Theobald Smith and others, added further brilliant chapters to our knowledge.

Since the beginning of the present century the growth of Veterinary Science has been phenomenal. In every branch of this science there have been remarkable developments. Indeed, it may be said that a New Veterinary Science has arisen unobserved by the general public. A quarter of a century ago the veterinarian was looked upon as a moderately useful though obscure member of the community, whereas to-day he is regarded as an essential factor in the economic machine of the State. A generation ago the value of a veterinarian was judged by his ability to cure a lame horse or an ailing dog; to-day the veterinary profession is judged by the measure of success which attends their efforts to keep their country free of epizootic diseases. Formerly the work of the veterinarian was individual, to-day it is national.

A.—Animal Diseases.

1. *Trypanosomiases.*

Probably no other single group of disease-producing organisms has retarded the agricultural development of the continent of Africa more than that of the trypanosomes. If the cattle population of Africa be estimated at about 40 million head, it is quite safe to say that this number could easily be doubled if the danger of trypanosome infection were removed. In Nigeria, for instance, only a portion of the drier Northern Provinces is suitable for cattle ranching; the much more fertile Southern Provinces are practically devoid of cattle on account of the ravages of Trypanosomiasis. Similar conditions obtain in almost every territory in Africa (except the extreme South). The soil is fertile, grazing is plentiful, the climatic conditions are favourable, but the presence of tsetse flies and trypanosomes renders cattle farming impossible.

Fortunately, we can record considerable progress in this field of work during recent years. The problem has been attacked along two lines mainly. A direct attack has been launched against the parasite by means of drug treatment; and an indirect attack on the disease has been made through a campaign against the transmitter, the tsetse fly. It may be stated at once that the third line of attack, namely, the immunisation of animals against infection, has not yielded very promising results.

In regard to *drug treatment*, a tribute should be paid to the early pioneers, especially Livingstone, who found that Arsenic

blood of animals. Untiring efforts on the part of later investigators (Ehrlich and many others) have brought to light a large number of active preparations, notably Arsenic and Antimony compounds and various dyestuffs. Still more recently further drugs have been added to the list, and these promise to give the stock farmer in infected areas a practical means of combating the disease and keeping his animals in good health and condition in spite of repeated infection. Among these drugs special mention should be made of *tryparsamide, Bayer* TZL (Germanin, Naganol) and *Antimosan.* The two former have also given excellent results in the treatment of human sleeping sickness, and the last-named which has quite recently been tried on a fairly extensive scale at Onderstepoort by Parkin, and in Tanganyika Territory by Hornby, has proved to be more effective in the treatment of *Trypanosoma congolense* infection than any drug previously used; at the same time the simple (subcutaneous) administration of this drug renders it more practical than those preparations which have to be given intravenously.

In all this work the veterinarian has kept in close touch with the medical man, on the one hand, and the synthetic chemist on the other.

In the *campaign against the tsetse fly* the basis of co-operation has had to be broader still. Entomologists, botanists, ecologists, medical men and veterinarians have all combined to study this problem. Time and space prevent me from discussing in detail the progress which has been made in this work. But attention should be directed to the very valuable investigations carried out in Tanganyika Territory by Swynnerton and his co-workers. The volume of our knowledge of the life-history and habits of the various species of tsetse flies is being added to year by year, but the rate of progress is not commensurate with the importance of the problem. Governments must realise that the tsetse fly is holding up the advancement and civilisation of Africa. Money and men should be made available for this work, however 'theoretical' it may appear. It is the study of precisely these 'academic' aspects of the bionomics of the tsetse fly, which will probably ultimately lead to the solution of the trypanosome problem.

Only a few words need be added about those trypanosome infections which are *carried mechanically by ordinary biting flies.* The most important of these is 'Surra'

in India and other countries. Great advance has been made since September, 1880, exactly 50 years ago, when Evans, the 'Inspecting Veterinary Surgeon' of the Government of Madras, was sent to the Punjab to investigate this disease, and when he succeeded, in a remarkably short time, in discovering its cause. Since then much work has been done, especially by Nieschulz in the Dutch East Indies, on the transmission of this disease, and good progress has also been made in regard to the drug treatment.

It is with great satisfaction that the fact can be recorded that this veteran of science, Griffith Evans, the discoverer of the first pathogenic trypanosoma, is still alive to-day, with more than four score years and ten to his credit, and is able to watch, from his home in Bangor, the progress which has been made in this field of work.

One further trypanosome disease should be mentioned here, namely, *Dourine.* Known for about 150 years, this disease has been responsible for very heavy economic losses to horse breeders in Europe, and other countries. With the aid of modern methods the disease was eradicated from most of the closely settled and well organised Western European states. But in the vast open spaces of Canada and other countries, its eradication proved to be a much more difficult problem. It was only when Watson in Canada succeeded in perfecting a delicate diagnostic test for the detection of the infection, that the eradication of the disease could be attempted seriously, and the results of the subsequent campaign in Canada have been entirely satisfactory. It should be added that Watson's success has stimulated further research into the problem of diagnosing other trypanosome infections by serological methods. A fair amount of success has attended these efforts and quite recently Robinson at Onderstepoort has reported further progress in the serological diagnosis of *Trypanosoma congloense* infection.

2. *Piroplasmoses.*

Under this heading are included diseases like Redwater or Texas Fever of cattle, Biliary Fever of dogs and horses, 'Gall-sickness' or Anaplasmosis and East Coast Fever of cattle.

Their ætiology was completely obscure until Theobald Smith and Kilborne in America, in a series of brilliant researches extending over the years 1888 to 1892, succeeded in elucidating the nature of the first-named disease. Not only did these investi-

gators discover the causal organism in the blood of infected cattle, but they also proved that the disease was transmitted by ticks and that the infection passed through the egg of one tick from one generation to the next. All this was completely new to Science: it was the first time that the transmission of a mammalian disease through an invertebrate host had been proved experimentally. This contribution to science by two veterinarians is worthy of special note.

Theobald Smith, like Griffiths Evans, is still able to day to watch the progress of the work which he initiated many years ago. In the case of '*Redwater*' great advances can be recorded. The direct method of attack is eminently satisfactory, thanks to the discovery by Nuttall and Hadwen in 1909 that the drug Trypanblue has a specific action on the parasite of Redwater of cattle and Biliary fever of dogs. The treatment is so successful that the disease has lost much of its terror since the discovery of the value of this drug.

In some of the other '*piroplasmoses*' (in the wider sense of the term), no such simple treatment is available. As a matter of fact, in the case of Anaplasmosis and East Coast Fever of cattle, no satisfactory method of treatment is known. In these cases, therefore, prevention should be aimed at.

Various methods of preventive inoculation against Anaplasmosis have been advocated. In South Africa Theiler, who originally described the parasite (*Anaplasma marginale*) causing Anaplasmosis, found a second species or variety (*Anaplasma centrale*) which differed from the first, not only as regard to its relative position in the red blood corpuscle, but also as regards its virulence. It was found that the infection of blood containing *Anaplasma centrale* invariably produced a milk infection, even in imported cattle, but that this infection conferred sufficient immunity to protect animals against the fatal *Anaplasma Marginale* infection.

This method of immunisation has been practised in South Africa for nearly twenty years and has been the means of saving thousands of animals. The *Anaplasma centrale* strain has also been sent to other countries where the same method has been used with good results.

Of the diseases mentioned in this section, East Coast Fever is the most formidable because of the very high mortality attending it. This disease must have cost South Africa several million pounds since its first appearance nearly 30 years ago. The loss to the country has been partly direct through the death of many thousands of animals, partly indirect through the costly organisation which it is necessary to maintain to fight the disease.

It is impossible in this brief review to discuss the methods employed in the *eradication of East Coast Fever*, or the many practical difficulties encountered in this campaign. For our purpose it is sufficient to state that the *dipping of cattle in an arsenical bath* has proved to be a very valuable aid in the fight against East Coast Fever or any other tick-borne disease.

In South Africa dipping has been practised since the beginning of this century, and has now become an integral portion of the daily routine of farming. No up-to-date stock farm can be found to-day without at least one dipping tank. The dip was originally intended chiefly as a weapon in the fight against tick-borne diseases, but to-day it is largely used merely to keep the cattle free of ectoparasites, quite apart from the fact that some of these parasites may be carriers of disease. The necessity of keeping cattle free of ticks is obvious to anyone who has lived in a tropical or semi-tropical tick-infested country. As an illustration, the fact may be mentioned that on the Natal Coast, before the days of dipping, it was rare to see a cow with more than one or two teats intact, and it was impossible to raise more than about 30 per cent. of the calves; whereas to-day, thanks to the dipping tank, all the udders and teats of the cows are healthy and it is nothing unusual to raise 95 per cent. or more of the calf crop. Even if all the tick-borne disease should now disappear, the majority of farmers in South Africa would continue to dip their animals regularly.

The extent to which dipping is practised to-day may be guaged by the fact that there were in the Union of South Africa in 1929 more than 13,500 dipping tanks. If we assume that the average dipping interval is eight days (the actual intervals are three, five, seven or fourteen days), and that the average number of animals that pass through a tank on a dipping day is 200 (frequently the number is as high as 4,000), we find (calculating on this very conservative basis) that about 120,000,000 cattle passed through the dipping tanks last year.

AN IMPROVED BODE'S LAW.

By F. H. LORING.

The atom has been likened to the planetary system, so that anything in general concerning the planets should be of interest to those studying atomic physics.

Bode's law is one of particular interest in this connection; but, as everybody knows, it breaks down *completely* at Neptune. Moreover, it is not mathematically regular in its starting term, which has been often remarked (see, for example, Russell, Dugan and Stewart's ASTRONOMY (1926), vol. I, pp. 235-237). The newly discovered planet, Pluto, raises another difficulty. The first two difficulties can be overcome by using *two* series of numbers in the equation (that is to say, two sorts of arithmetical progression) thus :—

$$n'm/n''+4=D;$$

where n' is taken progressively as 0, 1, 2, 3 4, 5, 6, 7, 6, 5, 4, 3, 2, 1; m is the geometrical-progression series, beginning at $1\frac{1}{2}$, doubling each time, being used progressively; n'' is a series of numbers 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, also used progressively; and D is the mean distance of the planet from the sun in astronomical units multiplied by 10. To make this clear see Table I.

TABLE I.

			Calc.	Planet	Obs.
0 × 1½ = 0	0/0 = 0	0 +4 =	4	Mercury	3.9
1 × 3 = 3	3/1 = 3	3 +4 =	7	Venus	7.2
2 × 6 = 12	12/2 = 6	6 +4 =	10	Earth...	10.0
3 × 12 = 36	36/3 = 12	12 +4 =	16	Mars	15.2
4 × 24 = 96	96/4 = 24	24 +4 =	28	Asteroids (mean)	26.5*
5 × 48 = 240	240/5 = 48	48 +4 =	52	Jupiter	52.0
6 × 96 = 576	576/6 = 96	96 +4 =	100	Saturn	95.4*
7 × 192 = 1344	1344/7 = 192	192 +4 =	196	Uranus	191.9
6 × 384 = 2304	2304/8 = 288	288 +4 =	292	Neptune...	300.7
5 × 768 = 3840	3840/9 = 426.6	426.6+4 =	430.6	Pluto...	—
4 × 1536 = 6144	6144/10 = 614.4	614.4+4 =	618.4	—	—
3 × 3072 = 9216	9216/11 = 837.8	837.8+4 =	841.8	—	—
2 × 6144 = 12288	12288/12 = 1024.0	1024.0+4 =	1028.0	—	—
1 × 12288 = 12288	12288/13 = 945.2	945.2+4 =	949.2		

* Sir James Jeans in his THE UNIVERSE AROUND US (1929) page 245, says :— " It is significant that the average orbit of all the asteroids agrees almost exactly with that of the planet which Bode's law would require to exist between Mars and Jupiter."

To justify the validity of the equation 0/0=0 (see Table I), it is only necessary to write the n'' series thus :—

TABLE II.

n''	*Diff.*
0.00001	
	1.00001
1.00002	
	1.00001
2.00003	
	1.00001
3.00004 &c.	

Then $0 \times 1\frac{1}{2} = 0$ without question. $0/0.00001=0$, also without question. Therefore, since the decimal fractions have negligible influence on the values following, $0/0=0$ may be interpreted correctly when this true type of series is kept in mind, and Table I may stand as shown.

It is obvious that the choice of the decimal value (or values) is immaterial so long as it is of small magnitude, as it merely fixes the starting value, that otherwise might be thought to be anything from 0 to infinity, particularly when divorced from the series.

The fact that in this case the values of the series are not absolute whole numbers is suggestive that nowhere in natural phenomena can absolute whole numbers apply or be used in formulæ if sufficiently precise.

Of course the formula does not give values in *exact* agreement with those measured, but this need not be a serious matter, as there would have been disturbances which cannot be taken into proper account

In scientific analyses, *series* are important, these being arithmetical, geometrical, etc., and the one that reaches a maximum and then declines is found in nature; but that being so does not justify a person calling the above *a law of nature*. This expression is becoming obsolete in science. Man's laws are not to be so labelled. It would be better to call the above scheme an *empirical rule*. Such rules are not for aids to memory, as some may think, but become useful in exploring unknown regions whereby discoveries are made. They serve sometimes as useful tools.

There is a parallel illustrating a part of the statement just above. If the chemical elements be arranged in the order of their atomic numbers their *characteristic* valencies can be expressed by two series thus :—

0, 1, 2, 3, 4, 3, 2, 1
0, 1, 2, 3, 4, 5, 6, 7

For example, nitrogen has a maximum valency of 5 and a minimum valency of 3. Lithium has a maximum valency of 1 and a minimum valency of 1, fitting the definition to the duality shown.

In Table I it will be seen that, leaving out of account the asteroids, the *plus* and *minus* differences (respectively added) are practically identical numerically.

In the case of Pluto, now to be considered, it should have a distance from the sun of 43 units, according to the above modification of Bode's so-called law, and therefore its period should be 282 years. This value is Lowell's prediction exactly (the lower one of two), but it appears that the distance and period are not so great as above, so that the rule here given may break down slightly at Pluto. The value computed by Dr. Crommelin from the data available (see *Nature*, 1930, *126*, 70) is 251 years, which would make the mean distance about 40 units, using here rounded-off figures. Comparing 430.6 with 400 gives an excess difference of $7\frac{2}{3}\%$, which is not so bad considering the distance of the planet from the sun.

The percentage difference is, by the way, calculated thus :—

$$430.66 \times 0.25 = 107.666$$
$$400. \quad \times 0.25 = 100.000 \text{(standard)}$$

7.666%

A note appearing in *Nature* (Sept. 27, 1930, *126*, 485) states that Prof. M. Wolf at Königstuhl confirms the period adopted in the *Lick Bulletin*, No. 427, which is 249.1661 years. This would make the mean distance $39^3/_5$ astronomical units, which compared with 43.06 makes the latter value $8\frac{3}{4}\%$ high.

It would therefore appear that the above rule *gives all the values, the greatest error* being just under 9% in the case of the most distant planet known definitely, namely, Pluto.

It may be mentioned here as a reminder that an astronomer, Titius, was the first one to find a rule connecting the planetary distances, and that Bode, also an astronomer, took it up and the rule became known as *Bode's law*. Some writers designate it as the *Titius-Bode rule*.

DETECTING MUSTARD-GAS.

Red Cross Competition to Close in December.

The International Red Cross Committee at Geneva announces that the International Competition for the discovery of a detective re-agent for the detection of mustard-gas in the air, which was started on July 1, 1929, is to close on December 31st. The prize offered is 10,000 Swiss francs (£400).

The competition is the first step in a Red Cross campaign for the protection of civilians in the event of war. It is to be followed, if funds permit, by other international competitions to discover, among other things, the best civilian gas mask and the best means of purifying the air in subterranean places in which civilians may take shelter during air raids.

Full particulars of the competition may be obtained on application to the International Red Cross Committe<, 1, Promenade du Pin, Geneva.

BOARD OF TRADE ANNOUNCEMENT.

Key Industries.

Representations have been made to the Board of Trade under Section 10 (5) of the Finance Act, 1926, regarding Germanium oxide and Scandium compounds.

Any communication should be addressed to the Principal Assistant Secretary, Industries and Manufactures Department, Board of Trade,, Great George Street, S.W.1., within one month from the date of this notice.

IS THE HISTORY OF PHARMACY A WORTH WHILE STUDY?

By George D. Beal.

The study of history connects the past and present in our minds. It pictures for us the story of the successes and failures of men and nations. When we read it understandingly, we find the answers to many of our present problems. Men confronted with situations strikingly similar to ours, have acted wisely or unwisely as we ourselves may act.

Nearly every professional problem to-day has its counterpart in the present and past experiences of other trades, professions and industries. They have not always appeared in the same form and do not appear in identical fashion to-day to two professions. But studied apart from their modern relationships, they appear to be governed by the same economic or physical laws as those problems of a century or more ago. It is only because of the greater number of processes and products, the changing trends of merchandising and the greater magnitude of our political groups that the professional problem seem to posses a different form and color.

In following the history of any science, particularly one governing professional proctice, the principle benefit to be obtained is the experience of others as a guide to present action as well as anaid in future planning. These records are the stimuli to progress and the promise of reward that key up the young investigator or business man in his moments of depression.

Another benefit of the historical study of a science is the appreciation of the logical steps by which the knowledge and practice of the present day has been built up. This appreciation is a most potent factor in stimulating the investigative instinct, especially on the part of the younger members of the profession. No worth-while investigation, whether in pure science or its industrial applications, is successfully begun without a delving into the records.

There can be no genuine scientific training without historical study. This is demonstrable in the companion science of chemistry. Looking back at the writings of the alchemists, their mystical treatment of chemical reactions, their ambiguities in description, and their clouding of formulas with mythical references, astronomical and astrological allusions and symbolic characters instead of written words, seem like either child's play or the work of slightly deranged intellects. Their powers of observation were keen, their reasoning surprisingly logical, and their faulty conclusions are as likely to have been based upon the philosophies of the ancients as upon imagining of their own. But we must do more than give them credit for laying the foundations for pur research. While many of them in their way were exponents of the field of pure science, both chemical engineering and manufacturing pharmacy were treated in a reasoning way, and the foundations for present-day practices laid.

Apart from the laying of foundations for the utilization of science by industry, the experimental science of alchemy, verging into chemistry, began experimenting vaguely in the companion fields of medicine and botany, so that through iatro-chemistry come biochemistry, pharmacology and that chemical study of drugs and medicines which today constitutes the field of pharmaceutical chemistry. The chemical scinecces, of which pharmacy is one, are almost hopelessly tangled in their origins, so that the history of one must be studied in all of the others.

This conclusion is further warranted by the close relationship that has existed between pharmacy and chemistry from the beginning, not only in the use of the name chemist for the profession of the pharmacist, but in the extent to which the chemists of the older days were engaged in the practice of pharmacy. In the absence of chemical manufacturing plants the dealer in chemicals must likewise be the producer thereof; and in the absence of chemical industries, the dealer in chemicals must alike supply the needs of the dyer, the tanner, the housewife and the physician. It is not strange that a century and a half ago the important discoveries in inorganic chemistry were made by pharmacists, that a century ago the name pharmacy preceded that of chemistry in our leading journals devoted to the chemical sciences, and that pharmaceutical chemists through their studies of vegetable drugs went a long way in laying the foundations of organic chemistry.

This traditional union between chemistry and pharmacy is felt just as strongly to-day as a century ago. If a new organic compound is not obviously a dyestuff, a resin or an explosive, the immediate hope is that it will possess medicinal properties. And upon what grounds will such a hope be based Upon analogies in structure to the active

principles of animal or vegetable drugs whise value has been proved by our predecessors.

The histor of pharmacy should be an important part of every pharmaceutical curriculum and its written records upon the book shelves of every pharmacist. It should not only be treated as a special subject in the curriculum because of its cultural and inspirational value, but should be an everyday part of the presentation of each branch of pharmacy.

Let us say, then, that following the history of pharmacy, as of any other profession or art, accomplishes these things. It serves to impress the student with the extent to which observation, experience and the unconcious grasping at conveniences which almost automatically present themselves will eventually direct energies along labor-saving lines to economical manufacturing operations.

It brings to the mind of the student more forcefully than in any other way the interdependencies that exist among the natural sciences, causing a realization of what may be learned each from the other and what ma be gained by the encouragement of mutual respect and intercourse.

By tracing the history of the medicinal agents and pharmaceutical operations from their beginnings, it aids in formulating for the student the theories of these operations and behaviors.

Finally, by relating the studies and labors of the masters, it develops in the mind of the apprentice the thought of pharmacy as an honorable profession, one ranking above mere trades. Many persons feel that pharmacy is passing through a critical economic stage at this time. The concentration of manufacturing pharmacy in large establishments, changing fashions in the practice of medicine, and the growth of new merchandising metrods have given to the casual observer at least, the thought that merchandising pharmacy of 1930 is vastly different from that of 1895. Modern trends in the administration of schools and colleges have likewise changed the methods of pharmaceutical education. It seems, then, that pride in profession, and respect for past developments, will do much to place the pharmacists of the present in a frame of mind which will continue to hold them in positions of business and community leadership which

COMBINED STEAM POWER AND HEATING.

A Notable Example in the Glass Industry.

By A Well-Known Engineer.

All the attention being given to steam driven superpower stations and overhead long distance transmission of electricity cannot alter the basic fact that a large number of industrial establishments, particularly chemical works for example, requiring both power and low pressure process and heating steam, can generate their own electricity at much less net cost. It will be remembered that a condensing steam turbine installation only operates on the average at about 16-20 per cent. overall thermal efficiency from the raw coal to the switchboard because no use is made of the exhaust steam which contains about 60 per cent of the total heat of the coal. This is of course lost in the condenser through which 450-500 tons of cooling water have to be passed per ton of coal burnt. In a chemical works, however, requiring steam for heating and general process work, generally say at 5-25 lbs. per square inch, a much more efficient practice is to generate electricity on the spot by a pass-out or back pressure engine or turbine, and use the exhaust steam for heating, giving an overall thermal efficiency of 50-60 per cent. A typical example of what can be accomplished, of which we have been able to obtain some details, is a back pressure high speed engine set operating at a well-known glass works in Great Britain. This is of the "Belliss" standard two crank, totally enclosed, compound type, coupled to an electric generator of 250 K.W., exhausting at 10 lbs. pressure for general heating and process work. The actual saving per annum is £1400 as compared with the purchase of outside electricity, although all the current was not generated by the back-pressure set.

When this is the case the saving goes up to £2710 per annum, with a total nett inclusive cost of only 0.316 pence per unit for the electricity generated. The actual cost for the previous 12 months, using part Corporation supply and part independent generation, as above, is 0.562 pence per unit, the total number of units being 1270,000. If however, the back pressure engine set is closed down the cost of electricity is 0.826 pence per unit. Here therefore, with a comparatively small installation, a saving is obtained of £1400-2710 per annum, while a further great advantage is the entirely inde-

outside interference, and without risk of stoppage of the supply. When a boiler plant has to be operated in any case to provide steam for process operations, as in thousands of works and other establishments, representing nearly 100 different industries, by far the most economical method is this principal of combined power and heating, as already indicated. The matter is quite simple, especially in view of the extensive practical experience that has been obtained, Belliss and Morcom Ltd., for example having supplied nearly 1500 installations, the saving varying from 25-50 per cent. of the coal bill in the case of works requiring say 50 per cent. of process steam or over. In general the principle of a power station with condensing steam units supplying with electricity a works that has to use low pressure steam for process work is on unscientific lines, and the same applied to the heating of large buildings where the ideal is to generate the electricity required for lighting in a small back pressure engine and use all the exhaust for the heating system.

JAPAN'S CHEMICAL INDUSTRY.

The Chemical Industry in Japan continues to make rapid increases in production, notwithstanding the retrograde movement which was experienced in most European countries as well as in Japan in 1929.

A large amount of Japanese Chemicals are exported to China, principally sulphur, sulphuric acid, nitric acid, bleaching powder, calcium carbide, and sodium sulphide. In conjunction with the development of the hydro-electric industry, the output of chemicals and electro-chemicals have increased extensively during recent years. The production of caustic soda is somewhat restricted partly by the limited demands for the electrolytic chlorine and partly by the unfavourable conditions of the soda-ash industry, this chemical, which plays an important in the rayon industry has to be imported.

Japanese production of other mineral acids and salts is on the increase notably ammonium suphate, but a difficult situation has arisen with regard to this important fertilizing agent. Japanese manufacturers have vastly increased their output during recent years, and meanwhile the price of imported sulphate in Japan for a time fell so low that Japanese producers appealed to the government to impose duties under the anti-dumping legislation which was enacted in 1920 but so far has never been applied. The case raises in an acute form the issue between the demands of industry and the needs of agriculture and this is the essence of the problem by which Japan is now confronted.

There has been during the last decade a strong tendency for chemical fertilisers to displace organic agents such as oil cake and fish manure. At the expense of these latter the consumption of artificial fertilisers has risen from 31 per cent. of the total in 1927 to nearly 50 per cent. in 1929. The principal artificial agents are ammonium sulphate, superphosphate of lime and compound fertilisers.

The ammonium sulphate manufactured in Japan is produced almost entirely by synthetic nitrogen plants (Casale, Claude, cyanamide and similar processes). The output of synthetic nitrogen compounds in Japan, Korea and Manchuria for 1929, in terms of tons of sulphate of ammonia, was estimated at 300,000, and will increase yearly as new plants come into operation. A new company the Show Fertiliser Company, expects to start operations shortly with a yearly capacity of 200,000 tons. The Corean works of Japan Nitrogen Company (an enterprise on a very large scale which if successful will be one of the largest artificial fertiliser plants in the world) commenced operations in 1930 and aims at an ultimate annual production of 500,000 tons of ammonium phosphate. Meanwhile, however the competition of imported fertilisers, the increase in demand for compound fertilisers and the general fall in purchasing power have struck a blow at mant of these undertakings, and at present, while manufacturing capacity is being increased output is being curtailed by 30 per cent., a phenomenon which, for that matter is not uncommon in Japan.

The electro-Chemical Industrial Company (in which the Mitsui Company is interested) have decided to manufacture cyanamide only, of which increasing amounts are now produced in Japan. Sample shipments are being sent to Europe aud America, as well as to Eastern countries, and business with Madras has already resulted.

GENERAL NOTES

KEY INDUSTRIES.

Renewal of Exemption Orders as Applied to Chemicals.

The question of the renewal of the Safeguarding of Industries (Exemption) No. 3 Order 1929, No. 4 Order 1929, and No. 1 Order 1930, made under Section 10(5) of the Finance Act 1926, is now under consideration by the Board of Trade. The articles covered by these Orders which exempt them from duty until December 31, 1930, are :—

Acid adipinic; acid hydrocyanic anhydrous; acid lactic which satisfies the requirements of the British Pharmocopœia; acid oxalic; amidopyrin (pyramidon; dimethylamidoantipyrine); ammonium perchlorate; barbitone (veronal; malonal, malourea; acid diethyl barbituric; diethylmalonylurea; hypnogen, deba); bromural (dormigene); celtium oxide; chinosol; cocaine, crude; dial (acid diallyl barbituric); dicyandiamide; didial (ethyl morphine diallyl barbiturate); dysprosium oxide; elbon (cinnamoyl para oxyphenyl urea); erbium oxide; ethylene bromide; eukodal; europium oxide; furfurol; gadolinium oxide; glycol ethers; guaiacol carbonate (duotal); holmium oxide; hydroquinone; integrators (planimeter type); R. lead acetate; lead tetraethyl; lipoiodin; lutecium oxide; mercury vapour rectifiers; metaldehyde; methyl cyclohexanol methyl adipate; methyl sulphonal (diethylsulphonemethylethylmethane, trional); neodymium oxide; nickel hydroxide; oxymethyl paraoxyphenyl benzylamine methyl sulphate; papaverine; phenacetin (acetparaphenetidine); phenazone (antipyrine; phenyldimethylpyrazolone; anlgesin; anodynine; dimethyl oxychinizin); phenetidine, para-; phytin; piperazine (diethylene-diamine; dispermin); planimeters; R. potassium chlorate; potassium ethylxanthogenate (potassium exanthogenate); potassium guaiacol sulphonate (thiocol); R. potassium hydroxide (R. potassium caustic; R. potassium hydrate); R. potassium permanganate; praseodymium oxide; pyramidon-veronal; quinine ethylcarbonate; radium compounds; resorcine (resorcinol); salol (phenyl salicylate); samarium oxide; styracol (guaiacol cinnamate); sulphonal; synthalin; terbium oxide; thulium oxide; urea (carbamide); vanadium-silica compounds specially prepared for use as catalysts for sulphuric acid manufacture ytterbium oxide; yttrium oxide.

CENTRAL EUROPEAN INDUSTRIAL FAIRS.

Despite the trade depression that prevails throughout practically the whole of the world there would seem to be no diminution in the interest shown in the various Trade Fairs which are regularly held in Central Europe. True, it is said that the number of exhibitors and the extent of the business transacted at the Leipzig Samples Fair was not so large as usual but so far as the other centres are concerned the space taken, the number of visitors and the sales effected have been well maintained. This is particularly true of the three Czechosolvak Trade Fairs at Liberec (Reichenberg) Bratislava and Prague.

The textile fair at Liberec was quite successful and has improved the position of the local industries. The Danube Fair at Bratislava is not a very large affair so far as size and exhibition space is concerned, but it is important as a means of exhibiting goods before visitors from the eastern parts of Central Europe and the Balkans. Bratislava is an inland Danube port at the junction of three states, Hungary, Austria and Czechoslovakia, and is also the capital and trade centre of Slovakia. Its Danube Fair attracts visitors from a very wide area and these are buyers for provincial towns and agricultural lands—a market by no means yet fully exploited. The fair recently held attracted more visitors than ever and all available space was occupied Chemical industries were relatively well represented and although Czechoslovakia produces considerable quantities of both heavy and fine chemicals these are inadequate for the home market. Naphtha is refined at Bratislava and there is an explosive factory near the town.

The Autumn Prague Samples Fair was also a success. There were 2,698 exhibitors, including 275 from abroad including a collective exhibit from British South Africa. The space occupied (44,000 square metres), was slightly less than that occupied at the Spring, 1930, fair, but the number of visitors was greater than ever and a record number of orders were taken.

CANADIAN MINING STATISTICS.

Decrease in Value.

The production in Canada of metals and non-metals for the first half of 1930 is valued at 116,860,409 dollars as compared with 123,702,334 dollars for the corresponding period of 1929, a decrease of six per cent. The lessened coal production, a lower output of asbestos and lower metal prices were the principal cause of the decline, according to the Report of the Dominion Bureau of Statistics. The outputs of the principal metals showed gains in volume but the increases were not great enough to set off the general decline in prices.

The gold production was 976,235 fine ounces valued at 20,180,568 dollars, a gain of 3.8 per cent. Copper output was 36.3 per cent. greater in volume but only 5.8 per cent. greater in value. The production of nickel during the first six months of 1930 totalled 55,113,525 pounds, valued at 12,995,271 dollars compared with 54,998,075 pounds valued at 12,872,029 dollars, the figures for the corresponding period of 1929. The production of lead was 172,204,062 pounds, which was 10.3 per cent. higher, but owing to the price decline the value of 7,229,984 dollars was 11 per cent. under that of 1929. The output of silver, 13,223,559 ounces valued at 5,457,098 dollars, showed a gain of 17 per cent. in quantity but a decrease of 12.7 per cent in value. The output of zinc was 123,371,385 pounds, an increase of 19.4 per cent in volume but a decrease of 19 per cent in value. The output of coal was 7,159,761 short tons valued at 25,854,127 dollars, a decrease of 18 per cent in both quantity and value.

The output of crude petroleum was 639, 884 barrels. The value of petroleum was 2,171,382 dollars, compared with 1,684,025 dollars, the value of 470,238 barrels for the corresponding period of 1929. The output of asbestos showed a decrease of 13 per cent. in quantity and 27 per cent. in value. The copper output was 157,536,826 pounds valued at 22,361,384 dallars, as compared with 115,586,068 pounds valued at 21,124,581 dollars in the first six months of 1929.

DYESTUFF ADVISERY LICENSING COMMITTEE.

The Board of Trade, on the nomination of the Association of British Chemical Manufacturers, have appointed Major L. B. Holliday, O.B.E., of Messrs. L. B. Holliday and Company, Limited, Hurredsfield, to be a member of the Dyestuffs Advisory Licensing Committee, in place of the late Mr. E. H[illegible]

HELIUM FOR DIRIGIBLES

Rear Admiral Moffett, Chief of the U.S. Bureau of Aeronautics, has made a declaration urging Congress to repeal the present law forbidding the export of helium gas. The United States can then make available to British and German dirigibles stores in helium which the United States is at present using exclusively.

Helium is much safer than highly explosive hydrogen and is likely to prevent such a disaster as that which occured to the giant airship R101 recently.

Helium, a non-inflammable and non-explosive element, is not obtainable in any part of the British Isles, but is known to exist in appreciable quantities in the United States and Canada. To import this gas it would be necessary to reduce it to liquid form and send it in great sealed high-pressure steel containers.

SMOKE WASTAGE £150 PER MINUTE.

Speaking at the Annual Conference of the National Smoke Abatement Society at Leicester on September 27. Mr. Arnold Marsh, M.Sc. Tech., the Secretary of the Society, said that if there efforts were being directed at the prevention of rickets among giraffes at the Zoo, they would probably get more support than they needed. As it was, their voices were but faintly heard because it was merely the children in the cities of gloom with whom they were concerned. Smoke was causing a wastage of £150 every minute in material values, but there was the even greater question of national health. Any cure-all might touch the heart strings of the generous, but prevention was cold and unromantic. They, were not without hope however, of an England with pure, clean air and a real, warm sun.

UNIVERSITY OF LONDON, UNIVERSITY COLLEGE.

Newmarch Lectures in Statistics.

A course of six public lectures on "Newmarch and His Contemporaries," will be given by Professor T. E. Gregory, D.Sc., (Sir Ernest Cassel Professor of Banking and Currency, London School of Economics and Political Science), on Tuesdays, October 21, and 28, November 4, 11, 18 and 25, at 5.30 p.m. The chair at the first lecture will be taken by Sir Basil P. Blackett, K.C.B., K.C.S.I. The lectures are open to the public without fee.

Proceedings and Notices of Societies

SOCIETY OF PUBLIC ANALYSTS.

An Ordinary Meeting of the Society was held at the Chemical Society's Rooms, Burlington House, on Wednesday, October 1st, *the President, Dr. J. T. Dunn, being in the* Chair.

Certificates were read for the first time in favour of Leonard Balmforth, B.Sc., F.I.C., Reginald Joseph Cole, B.Sc., Violet Dorothy Dudman, B.Sc., A.I.C., Frank George Edmed, O.B.E., B.Sc., A.R.C.Sc., F.I.C., Roy Gardner, D.Sc., F.I.C., William Victor Griffiths, B.Sc., A.I.C., Daoud Younis Haddad, B.Pharm., Percy George Terry Hand, F.I.C., Magnus Herd, B.Sc., A.R.T.C., F.I.C., Gilbert Underwood Houghton, B.Sc., A.I.C., Archibald Robert Jamieson, B.Sc., F.I.C., William Jefferys Lesley, M.Sc., Ph.D., A.I.C., Allison Reginald Murray MacLean, B.A., M.Sc., Ph.D., Frederick Henry Newington, F.I.C., Colin Paterson, B.Sc., A.I.C.

Certificates were read for the second time in favour of : John Herbert Bushill, M.Sc., A.I.C., Edward Quentin Laws, B.Sc., A.I.C. and Hubert Taylor, B.Sc., A.I.C.

*The folloying were elected ordinary mem*bers of the Society :—Lionel Stuart Davis, Arthur Smith, B.Sc., A.I.C. and Snow Blagburn Tallantyre, B.Sc., A.R.C.Sc., F.I.C.; and Dr. G. C. Clayton, C.B.E., F.I.C. was elected an Honorary Member.

The following papers were read and discussed :—

Scientific Evidence relating to Firearms, with Special Reference to a recent Murder Trial. By G. W. Baker, F.I.C.

(Read and demonstrated by Mr. G. H. Perry, O.B.E., B.Sc., F.I.C. the War Department Chemist).

Scientific methods of investigation were used in examining the bullet and cartridge case found on the scene of a murder in Jerusalem *in August* 1929. By *means of* X-Ray photography it was established that the piece of a bullet found in one of the bodies was British ammunition, and it was also proved that it had been fired from a rifle of the same calibre and rifling as that of the accused. Further, their was conclusively proved by means of photomicrographs that the cartridge case found on the scene had been fired from the rifle of the accused, for the rifle. The extractor mark was also a very characteristic feature The Court found the accused to be guilty.

The Composition of Rye Oil. By J. W. Croxford, A.I.C. (Work done under the *Analytical Investigation Scheme*).

Two samples of rye, a sample of Ryvita crispbread, and a sample of rye flour, extracted by means of petroleum, yielded about 2 per cent. of oil. It was semi-solid, contained from 8 to 10 per cent. of unsaponifiable matter, had chemical characteristics similar to those of maize oil, and behaved like a semi-drying oil. Biological tests made by Professor Drummond have shown that rye oil has little, if any, vitaminic activity.

The Determination of Unsaponified Oil in Soap or Fatty Acids. By G. E. Lester Smith, M.Sc., A.I.C.

Modifications of the " emulsion test," in which the presence of oil in fatty acid is indicated by the turbidity of a solution of the ammonium soap in dilute alcohol, are described. As little as 0.05 per cent. of oil can be detected by the modified test, which is rapid and as sensitive as any other available. The test may be made quantitative by a determination of the volume of water required to produce incipient turbidity in an alcoholic solution of the ammonium soap under standard conditions.

NOTICES OF BOOKS.

Enzymes. By Prof. J. B. S. Haldane. Pp. viii + 235. London : Longmans, Green & Co. 1930. Price 14s.

Prof. Haldane's important treatise on the enzymes and their behaviour belongs to the series of *Monographs on Biochemistry*, published by Messrs. Longmans, and edited by Prof. Plimmer and Sir F. G. Hopkins. It is complementary to the work of the late Sir Wm. Bayliss (*The Nature of Enzyme Action*) in the same series.

An enzyme is defined as a soluble, colloidal, organic catalyst, produced by a living organism. Some are found in natural *secretions, such as digestive juices* and milk but the large majority can only be obtained from the interior of cells. Some idea of their tremendous activity may be illustrated by the fact that recent preparations of invertase can hydrolyse six times their weight of cane sugar per second at 15° C. Euler and Josephson's catalase preparation broke up (1927) 220 times its weight of H_2O_2 per second at 0° C. Other examples are given

a very wide field. It deals with the influence of enzyme concentration and hydrogen ion concentration, the union of the enzyme with its substrate and related compounds, the influence of temperature and radiation on enzyme action and the course of enzymatic reactions and its mathematical aspects.

Such matters as the function and nature of co-enzymes, activators, kinases and the poisoning of enzymes are all discussed at some length and an attempt is made at the classification of these bodies.

Altogether the *Monograph* is a valuable addition to the series and will be of considerable interest to biochemists, biologists and organic chemists.

Recent advances in Physical and Inorganic Chemistry by PROF. A. W. STEWART, D.Sc. Sixth edition, pp. XII + 387. London : Longmans, Green and Co. 1930. Price 18s.

The latest edition of Prof. Stewarts' Recent Advances in Physical and Inorganic extends to 400 pages in which a concise account is given of the latest progress and the present state of knowledge in the main fields of inorganic chemistry. In the present edition some of the older material has been compressed or deleted, whilst five new chapters have been inserted and others have been extended.

Among the fresh material are sections dealing with the newly discovered elements. Thus further details are given concerning hafnium and there are summaries of the discoveries of Illinium and dir-manganese. Other work on the newer clements and those still labelled " missing " has also been summarised by Prof. Stewart.

Such important subjects as the isotopes and the results obtained with the mass spectrograph are described clearly and in considerable detail and the latest work on subatomic phenomena also finds a place in the edition of Recent Advances.

The prominence attained recently by the separation of so called varieties of hydrogen is reflected bv the inclusion of a chapter entitled " Active Hydrogen " and there is also a full account of the newer hydrides, with comments on the significance of these compounds.

Since the discovery of radio-activity at the close of last century their has been a great change in the development of chemical science and it is with this in view that Prof. Stewart has from time to time reviewed the progress in the min branches of chemistry. Whilst it is possible to cite omissions of important recent researches so much has been included that the present edition of Prof. Stewart's *Recent Advances in Physical and Inorganic Chemistry* constitutes a valuable summary of the present stage of evolution in chemical science.

J.G.F.D.

CORRESPONDENCE.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—CENTENARY FUND.

(*To the Editor of* THE CHEMICAL NEWS.)

Sir,—The British Association for the Advancement of Science has recently concluded a most successful meeting at Bristol, at which discussion has taken place as to the arrangements for the Centenary Meeting, to be held in London, with the gracious approval of H.M. The King, patron of the Association, and under the Presidency of General Smuts.

The Association during its first century of existence may claim to have established itself, first as a national, and more lately as an Imperial institution. Its Council is of opinion that, despite the steady support which it receives from its members, and the generosity of certain individual benefactors, and of those home cities or Dominions, which from time to time entertain it for its annual meetings, the power the Association has acquired for the advancement of science might be far more effectively exercised if it possessed a larger endowment. The Council would be loth to risk narrowing the present wide field of membership and therefore of interest and usefulness by increasing the subscription for the Annual Meeting, though that still remains at the figure of one pound at which it was fixed in 1831, and has even been recently reduced to half that sum for junior student members. The Council has therefore decided to appeal for a Centenary Fund or £40,000.

A first charge upon that fund or the income from it must be the expenditure appropriate to the fitting celebration of the Centenary itself. In this connection it is the object of the Council to make the Centenary Meeting an occasion for the gathering of the largest possible representative body of scientific workers from the Dominions, and by this means to repay something of the debt which the Association owes to those Dominions whose hospitality its members have enjoyed.

Beyond this immediate object the Association earnestly desires to maintain and extend its annual financial support of scientific research, to discharge fittingly the trusteeship of Darwin's house at Downe, recently entrusted to it in custody for the nation and indeed for the civilised world, and to assure the means of carrying out its Imperial responsibilities. Its financial constitution has always forced it to live in a measure from hand to mouth.

The contributions towards research from the funds of the Association fluctuate annually with its net balance of receipts over expenditure, and it is therefore often a matter of chance whether the Association is able to support any particular research in accordance with its intrinsic importance. Not infrequently the Association has to count the cost, with too much appearance of parsimony, before accepting an invitation to a particular place, having regard to the prospects of local support, or to the distance and expense involved for members who attend. Where the Association is summoned to carry on its public mission, there the Council feels that it should be able to go without question or limitation on financial grounds.

Those who serve the Association by contributing to its programme, carrying out its researches and organising its reception at successive places of meeting, do so voluntarily, and it has been said that to voluntary service in the interests of science the whole story of the British Association stands as one great memorial. The object of the present appeal is to strengthen the organisation which makes use of that service.

Contributions to the Centenary Fund will be gratefully acknowledged by the General Treasurer, British Association, Burlington House, London, W.1., and it is competent for donors to hypothecate their contributions, if they so desire, for research in any particular department of science, or for any of the objects which have been indicated above.

We are, Sir,
Your obedient servants,
F. O. Bower,
President.
J .C. Stamp,
Hon. Gen. Treasurer.
John L. Myres,
F. J. M. Stratton,
Hon. Gen. Secretaries.
O. J. R. Howarth,
Secretary.
Burlington House. London, W.1.

PUBLICATIONS RECEIVED.

Scientific Papers of the Institute of Physical and Chemical Research, Tokyo, Japan.

"Zeeman effect of Neon." By K. Murakawa and T. Iwama No. 254. Price 20 Sen.

"Isotope effect in the Spectrum of Neon. I." By H. Nagaoka and T. Mishima. No. 255. Price 60 Sen.

"Studies on the Coagulation of Von Wiemarn's AUF Sols. II." By E. Iwase. Price 20 Sen.

"Uber die katalytische Reduktion des Kohlenoxyds unter gewohnlichem Druck. V.—Die Einflusse von Titanoxyd, Zirkoniumoxyd und Ceroxyd auf den Kobalt—Kupferkatalysator." By S. Kodama.

"On the Promoter action in the Catalytic Oxydation of Methane with Steam." By Kubota and T. Yamanaka.

"The separation and determination of Gallium. II.—The Separation of Gallium and Aluminium from each other, and the Determination of These Elements." By S. Ato. Nos. 257-259. Price 55 Sen.

"*Notes on Helium Spectrum* in the Presence of the Electric Field." By Y. Ishida. No. 260. Price 45 Sen.

"On Tea Tannin Isolated from Green Tea." By M. Tsujimura No. 261. Price 15 Sen.

"Experimental Studies on Absorption by Means of X-Rays." By M. Hirata.

"High Voltage Phenomena in Insulating Oil. Part II." (*Abridgement*). By T. Nishi, K. Ohtsuka and Y. Arakawa. Nos 262-263. Price 60,

"Fine Structures in the Band Spectra of Hydrogen and Helium examined under high Resolution." By S. Imanishi. No. 264. Price 20 Sen.

"A method for the Extension of Balmer Series in Laboratory." By T. Takamine and T. Guga. No. 265. Price 15 Sen.

U.S. Department of Commerce. Washington D.C.

Interchangeable Ground Glass Joints. Commercial Standards CS21-30. Price 15 Cents.

Department of Scientific and Industrial Research, 16, Old Queen Street, London, S.W.1.

Building Research.

The Estimation of Free Calcium Hydroxide in Cements. Technical Paper No.

UNITED STATES DEPARTMENT OF AGRICULTURE.

Food and Drugs.

Administration. Notices of Judgment under the Food and Drugs Act.

UNITED STATES DEPARTMENT OF THE INTERIOR GEOLOGICAL SURVEY. WASHINGTON D.C.

Mineral Resources of Alaska. By Philip S. Smith and others. Bulletin 810. Price 50 cents.

COMMONWEALTH OF AUSTRALIA MELBOUNE.

Department of Scientific and Industrial Research. Investigations, on "Spotted Wilt" of Tomatoes. By Geffory Samuel, M.Sc., J. G. Bald, B.Agr.Sc., and H. A. Pittman, B.Sc.Agr., Bulletin No. 44.

United States Department of the Interior Geological Survey. Washington. D.C.

The Flora of the Denver and Associated Formations of Colorada. By Frank Hall Knowlton. Professional Paper 155.. Price 80 cents.

The Upper Cretaceous Floras of Alaska. By Arthur Hollick with a Description of the Plant-bearing-beds. By George C. Martin. Professional Paper 159. Price 80 cents.

Surface Water Supply of the United States 1926 Part XI Pacific Slope Basins in California. N. C. Grover, Chief Hydraulic Engineer, H. D. McGlashan and F. F. Henshaw, District Engineers. Water Supply Paper 631. Price 65 cents.

Surface Water Supply of the United States 1926 Part XII North Pacific Slope Basins. C. Pacific Slope Basins in Dregen and Lower Columbia River Basin. N. C. Grover, Chief Hydraulic Engineer, F. F. Henshaw and G. L. Parker, District Engineers. Water Supply Paper 634. Price 25 cents.

Mineral Industry of Alaska in 1928 and administrative report. By Philip S. Smith. Bulletin 813-A. Price 15 cents.

Geology and Ore Deposits of the Wood River Region, Idaho. By J. B. Umpleby, Lewis G. Westgate and Clyde P. Ross, with a description of the Minnie Moore and nearby Pass by D. F. Hewitt. Bulletin 814. Price 90 cents.

Forthcoming Events.

THE SOCIETY OF DYERS AND COLOURISTS.

MANCHESTER SECTION.

The first meeting of the session will be held on Friday, Oct. 17th, 1930, at 7 p.m., at 86, George Street, Manchester, when the Chairmans Address will be given by F. Scholefield, Esq., M.Sc., F.I.C.

THE ROYAL INSTITUTE OF PUBLIC HEALTH.

Wesdesday, October 22nd, 1930, at 4 p.m. at the Lecture of the Institute, 87, Russell Square, London, W.C.1. The Prevention of Pre Cancerous States and the Arrest of Cancer. By Prof. W. S. Lazarus-Barlow, M.D., F.R.C.P.

UNIVERSITY OF LONDON.

ADVANCED LECTURES IN CHEMISTRY.

A course of three lectures will be given at the Imperial College of Science and Technology, by Professor K. Freudenberg (Professor of Chemistry in the University of Heidelberg), at 5.30 p.m. on October 20th, 21st and 22nd.

Lectures I. and II.—Some aspects on the structure of Cellulose and other Polysaccharides; with remarks on the constitution of Lignine. Lecture III. Researches on the Constitution of Insulin.

At the first lecture the chair will be taken by Professor Jocelyn F. Thorpe, C.B.E., F.R.S. (Professor of Organic Chemistry in the University).

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

28,682.—(I. G. Farbenindustrie Akt.-Ges.). —Manufacture of alkali chromates. Sept. 24.

28,747.—(I. G. Farbenindustrie Akt.-Ges.). —Manufacture of sulphuric acid esters of the leuco compounds of indigold vat dyestuffs containing nitro groups. Sept. 25.

28,888.—(I. G. Farbenindustrie Akt.-Ges.). —Manufacture of derivatives of 1 : 4 : 5 : 8-naphthalene-tetracarboxylic acid Sept. 26.

Specifications Published.

835,169.—(I. G. Farbenindustrie Akt.-Ges.). —Process for the manufacture of chromium compounds of azo dyestuffs forming metallic compounds.

335,280.—Verhave, sen., T.H.—Preparation of 2 : 3-Butyleneglycol from carbohydrates.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

RESOLIN.

514,651.—Chemical substances used in manufactures, photography, or philosophical research, and anti-corrosives, but not including compounds for *preventing incrustation* in the water including any goods of a like kind to these excluded goods.—Chemical jackets of gas and oil engines, and no Works formery Sandoz, also trading as Chemische Fabrik Vormals Sandoz, and as Fabriique De Produits Chimiques Ci-Devant Sandoz, 60, Fabrikstrasse, Basle, Switzerland. Oct. 1st. (Associated) (By Consent).

PARAMURAL.

515,528.—Chemical substances used in manufactures, photography or philosophical research, and anti-corrosives, but not including a *chemical substance used in the* manufacture of printing pastes, and not including any goods of a like kind to a chemical substance used in the manufacture of printing pastes. —Blacklock & Macarthur, Ltd., 161 to 173, West Street, Tradeston, Glasgow. October 1st.

FOR SALE.
FIRST SIX VOLUMES OF "THE CHEMICAL NEWS."

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Vol. 3—January to June, 1861.
Vol. 4—July to December, 1861.
Vol. 5—January to June, 1862.
Vol. 6—July to December, 1862.

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AN IMPROVED BODE'S LAW. (EXPLANATORY NOTE.)

By F. H. LORING.

In order that no misconception should arise in connection with my statements *re* characteristic valencies on page 246, of this volume, the reader should consult J. A. V. Butler's THE CHEMICAL ELEMENTS AND THEIR COMPOUNDS (1930), pp. 77-80, where the whole matter is discussed clearly and tables are given which express the generality of the characteristic features I have shown on page 246.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

SECTION M.—AGRICULTURE.

VETERINARY SCIENCE AND AGRICULTURE.

By P. J. DU TOIT, B.A., Dr. Phil., Dr. Med. Vet., *President of the Section.*

(*Concluded from page 244.*)

3. VIRUS DISEASES.

The vast sums of money which have been spent in this country during the last few years on the eradication of *Foot and Mouth disease* should convince even the layman of the importance of this group of diseases.

In the olden days it was *Rinderpest* which caused the severest losses. It has been calculated that the losses in Europe during the eighteenth century amounted to 200 million head of cattle. The disease made its appearance in England in 1865. A Royal Commission was appointed and its report is of value to this day. Later on, improved methods of eradication and prevention were evolved, and to-day most countries are free of Rinderpest. However, in the Far East and in Central Africa the disease is still prevalent, and causes very serious losses.

Two recent outbreaks of Rinderpest, one in Belgium in 1920, and the other in Australia in 1923, both of which were eradicated completely within a few months, have again shown how far Veterinary Science has advanced during the last century and how much a country owes to an efficient Veterinary Service.

South Africa has been free of the two diseases just named for many years. But there are several other virus diseases which play a very important role. Among these '*Horsesickness*' and '*Bluetongue*' of sheep are perhaps the most important. An extensive study of the former disease by Theiler and his co-workers has yielded some very valuable results, but the problem of Horsesickness cannot be said to be solved. At present a method of immunisation with hyperimmune serum and virus is practised, and this method has given excellent results in mules. About 4,000 mules are immunised annually, and it has been stated that if the Onderstepoort Laboratory had produced nothing else except this method of immunising mules, its existence would have been justified.

In horses the method has not been quite so satisfactory. A method of immunisation of horses which would be safer, simpler,

cheaper and more reliable than the present method, would be of inestimable value to stock farmers right throughout Africa. Recent work at Onderstepoort with a formalised vaccine (by Du Toit and Alexander), seems to justify the hope that such a method will be found. The work was inspired by the brilliant researches of Dunkin and Laidlaw in England on another virus disease, Distemper for dogs.

The second important virus disease of South Africa is Bluetongue of sheep. The disease is of great economic importance and would have been a very serious hindrance to the sheep farmer had it not been for the fact that Theiler discovered a simple method of vaccination by means of which the losses from the disease can be reduced to a negligible quantity. Every year two or three million doses of this vaccine are issued to the farmers, and the ultimate saving to the country must be enormous.

Another African disease, '*Heartwater*' of cattle, sheep and goats, should be mentioned here. Formerly this disease was classified as a virus disease, but a few years ago Cowdry, working at Onderstepoort, found that it was caused by a Rickettsia. It is possible that this discovery may give us a clue to a successful method of combating this serious disease. In the meantime, all that can be done is to dip the animals to eradicate the tick which transmits the disease.

Of the many other virus diseases of animals only one more need be referred to here namely *Rabies*. This most dreaded of all human and animal diseases has been eradicated from many countries, and is being kept out by strict quarantine measures. In 1918 the disease was introduced into England with a dog which had been smuggled in in an aeroplane. Strict measures were put into force, and in a comparatively short space of time the disease was stamped out completely. Methods of preventive inoculation of dogs in countries where the eradication of the disease is very difficult, have been tried on a large scale. The results have on the whole, been very good, but it is too early to predict the future scope of these methods.

Before leaving this group, it is necessary to point out that virus diseases are not confined to our domestic animals, but are encountered in human beings, on the one hand, and in the lower animals (e.g. insects) and in plants on the other. Co-operation between medical men, veterinarians and plant [illegible] therefore, becomes imperative.

many scientific workers and great developments may confidently be expected in the future.

4. *Bacterial Diseases.*

Of the host of bacterial diseases only a few need be mentioned here.

The deadly *glanders* which was known before the time of Christ and which, 25 years ago still caused great losses among horses, and constantly threatened the human population, has now been practically eradicated from all civilised countries, thanks to the accuracy of the diagnostic tests which are used to indentify the disease.

Another disease which at one time was responsible for very serious losses and which has now practically disappeared, is *Pleuropneumonia* (*Lungsickness*) of cattle. In the year 1860 about 187,000 head of cattle are stated to have died in Great Britain of this disease; and the mortality in other European countries at that time was correspondingly high. Towards the end of last century the disease was stamped out in Britain and to-day the greater part of Europe is free of the disease. It may be added that South Africa, in spite of the fact that neighbouring countries are still infected, has been free of Lungsickness since 1915.

Anthrax is almost universal in its occurrence, but it is much more formidable in the tropics and sub-tropics than in the colder countries of Europe. In the latter countries it appears in sporadic cases, whereas in the former it behaves like any epizootic disease. For this reason its suppression in these countries becomes a matter of great urgency. The problem has been tackled on a big scale in Australia and South Africa by means of preventive inoculation. In the former country the disease has nearly been stamped out and in South Africa the campaign is carried on with great vigour. The excellent results obtained with the spore vaccine, now employed, promise complete success.

The position in the warm countries in regard to *Quarter Evil* (*Black Quarter*) [illegible] much the same as with Anthrax. The disease appears almost in epizootic form an[illegible] preventive inoculation on a large scale be[illegible] comes necessary. Very satisfactory resul[illegible] have been obtained in South Africa bot[illegible] with a germ-free filtrate and with a forma[illegible] ised vaccine.

Only one other bacterial disease can [illegible] mentioned here, namely, *Tuberculosis*. [illegible] 1901. Robert Koch, who about 20 years pr[illegible]

ease, startled the scientific world by announcing to a Tuberculosis Congress in London that human tuberculosis and bovine tuberculosis were two distinct diseases which were not communicable from the one species to the other. Unfortunately, this statement proved to be wrong. We know to-day that human beings do contract bovine tuberculosis, and for this reason most civilised countries adopt measures for the suppression of the disease in cattle. The United States and Canada are leading the world in this respect and have spent millions of pounds in compensation for the destruction of tuberculous reactors. Denmark, Germany, England and other countries are also doing much and have achieved a large measure of success in their efforts to supply to the population milk and beef free of tubercle bacilli. But very much remains to be done. In human being the mortality from tuberculosis is still high in all countries, and a considerable percentage of the deaths must be ascribed to the bovine strain of the organism. The disease in cattle *can* be stamped out provided enough money is made available.

Recently great interest has been shown in the attenuated strain of tubercle bacilli produced by Calmette and Guerin of the Pasteur Institute. Experiments in which it is attempted to immunise children and young animals, with this strain, are in progress throughout the world. It is sincerely hoped that all this work will prove that the method of Calmette and Guerin has given us yet another weapon against this insidious disease.

5. *Internal Metazoan Parasites.*

The only group that need be mentioned in this brief survey are the *Worms*. These parasites have become more and more important and to-day they actually constitute the 'limiting factor' in successful sheep farming in many parts of the world. This subject forms a highly specialised science of its own, the science of Helminthology: in which many notable successes have been achieved in recent years. It is almost unnecessary to add that this subject demands the close co-operation of zoologists, medical men and veterinarians.

Amongst the *Trematodes* the *Liverflukes* and *Schistosomes* of sheep and cattle deserve special mention. The latter group is not of very great economic importance, but is of great interest because of the close relationship between the disease in animals and Schistosomiasis (Bilharzia disease) in man recently (1929) how the campaign against the human disease can benefit from further study of the animal disease. This is particularly true of the method of treatment with tartar emetic and other modern drugs.

Liverfluke disease of sheep and cattle is a very serious problem in many countries in different parts of the world. In Germany, Nöller has organised what may be termed a national campaign against these parasites, and has achieved a large measure of success. Various preparations have proved to be very efficacious in the treatment of infected animals, and the application of modern principles of hygiene has reduced the incidence of the snails which act as intermediate host of both groups of worms just mentioned.

Generally speaking, the *Nematodes* or round worms are far more serious than either the Trematodes or Cestodes (tape worms). In many countries where sheep farming is conducted on an extensive scale, the infection with various nematode worms seriously threatens the industry. One or two examples may be mentioned.

The ordinary stomach worm of sheep (*Hæmonchus contortus*) is world-wide in its distribution and is the cause of very severe losses. Better farming methods will undoubtedly improve the position, but in the meantime farmers look to the veterinarian to rid their sheep of these deadly parasites. Various chemicals have been tried with varying degrees of success, but perhaps nowhere has the success been so marked as in South Africa, where, as a result of the researches of Theiler, Veglia, Green and others, a method of treatment was recommended which has proved the salvation of many sheep farmers. The method consists of the accurate dosage of a mixture of arsenite of soda and copper sulphate; and the extent to which this method has been applied may be gauged from the fact that at present some 25 million doses of the mixture are issued annually from Onderstepoort. The method is not perfect, but it has certainly been a great factor in making sheep farming a success where otherwise it would have been a dismal failure.

There are many other nematodes which threaten the sheep industry. *Œsophagostomum columbianum* and various species of *Trichostrongylus* are amongst the most important in South Africa. Treatment in these cases is not simple, but it is hoped that the work now proceeding at Onderstepoort (Mönnig and Le Roux) and in many

United States of America) will yield practical results.

One further fact must be emphasised here. The menace of worm infection has become so great that no sheep farmer can hope to be successful if he disregards the teaching of modern science. Overstocking of farms must be prevented at all costs; marshes must be drained or the sheep kept away from them; the sheep must be treated regularly according to the best methods known. If these precautions are adopted the parasites can be kept in check and profitable sheep farming will become possible; if the advice is ignored, then the financial loss to the farmer will be the smaller the sooner he gives up farming.

The great value of hygienic methods in farming has been proved in the case of *Ascaris* infection of pigs. Some years ago the pig breeding industry was seriously threatened by this parasite; whereas to-day, thanks to the researches of Ransom and others, the infection can be eliminated completely.

6. *External Parasites.*

The two most important groups of ectoparasites, the *ticks* and the *tseste flies* have already been referred to.

A further very important group are the *mites*. These minute parasites are responsible for the diseases known as *scab* or *mange in animals*, and have caused untold losses. In the fight against these diseases, the British Dominions have had very signal success. Australia and New Zealand have practically eradicated sheep scab completely, Canada is practically free of it, and in South Africa, where the presence of a large native population owning a very inferior class of sheep has made the campaign particularly difficult, the incidence of the disease has been reduced to infinitesimal proportions, and complete eradication within a short time is hoped for.

Another very important ecto-parasite of sheep is the so-called *Blowfly*. The trouble is caused by these flies depositing their eggs in the wool of sheep, especially in the soiled and moist parts, and by the resulting maggots causing serious damage to the wool and the sheep itself. The pest has assumed alarming proportions in Australia and is becoming more and more important in other countries, including South Africa. Determined efforts are being made to combat the pest and valuable progress has been achieved. In this research entomologists

7. *Diseases due to Poisonous Plants.*

That certain plants are poisonous and may have fatal effects when consumed by animals has probably been known for centuries. However, it is only during recent years that plants have been studied which produce diseases comparable with epizootic diseases. In this field of research South African workers have been prominent.

One of the most remarkable of these diseases is that known in South Africa as '*Gousiekte*' (rapid disease) of sheep, which was studied some years ago by Theiler, Du Toit and Mitchell. The cause of the disease was shown to be the plant *Vangueria pygmœa*. The remarkable nature of this disease may best be illustrated by the following incident: A farmer brought a flock of 1,760 sheep on to a farm where this plant was known to be present, and left them there for less than 24 hours. They were then removed to a clean farm and for about six weeks nothing happened. Thereupon the sheep suddenly started dying and within a few weeks 1,047 sheep had died. This strange occurrence is explained as follows: the poison contained in the plant acts on the heart muscle causing a cyocarditis with subsequent dilation of the ventricles. As soon as the process has reached a certain stage the animal dies of 'heart failure.' To the casual observer the disease presents all the characteristics of an infectious disease; in the case quoted above it certainly seemed as if the disease had 'spread' rapidly among the flock.

The elucidation of the cause of the disease was of great practical importance inasmuch as it enabled the farmer to enclose that portion of his farm where the poisonous plant grew, and to keep his sheep away from it.

Other no less remarkable diseases were studied by Theiler and his co-workers.

A disease called '*Geeldikkop*' (yellow thick head) in sheep was shown by Theiler (1928) to be due to a plant *Tribulus terrestris*, although more recent work by Quin, Steyn and others at Onderstepoort has shown that there are other factors to be considered in the causation of this disease.

'*Vomiting disease*' of sheep was studied by Du Toit (1928) and proved to be caused by *Geigeria* spp. The disease may produce very severe losses in certain years, especially after droughts, when the plant is very widespread.

Many other instances could be cited of diseases which assume great economic im-

poisonous plants. One final example may suffice to demonstrate the peculiar behaviour of some plant poisons. A disease of horses known as '*Jaagseikte*' was proved by Theiler (1918) to be due to *Crotalaria dura*. When the plant is fed to horses it produces, after a long 'incubation period,' a fever and certain characteristic changes in the lungs. On the other hand, if the same plant is fed to cattle it produces equally definite changes in the liver.

8. *Deficiency Diseases.*

The great importance of the *vitamins* in the nutrition of human beings is so well known that it need not be stressed here. In the case of the common domestic animals (except perhaps the pig, the dog and the fowl) the vitamins seem to be of far less importance than in human beings.

On the other hand, *mineral deficiencies* are, generally speaking, much more important in animals than in human beings. The reason for this is not far to seek: animals, in most cases, derive their nourishment directly from the products of the soil in a limited area; and if the soil should be deficient in any mineral, that deficiency will be reflected in the diet of the animal.

In recent years it has been found that large portions of the earth's surface are deficient in some mineral or other which is essential for the normal health and growth of animals. This subject was discussed by Dr. J. B. Orr, himself a pioneer in this field of work, in his presidential address to this Section five years ago.

In South Africa as well as in other African territories and in Australia the most serious deficiency is that of *Phosphorus*. Theiler and his co-workers have investigated the ill effects of this deficiency on cattle very fully. They have shown that cattle grazing on phosphorus-deficient pastures develop a depraved appetite for bones and other carcase debris, and this may lead to the ingestion of toxic material with fatal results ('lamsiekte' in South Africa); further, that such cattle remain stunted in growth, are late in maturing, are frequently unfertile, produce very little milk, and are very susceptible to various diseases. By the addition of a small daily ration of phosphorus to the diet, they were able to bring about an almost miraculous improvement in the condition of the animals.

As a result of the general feeding of phosphorus compounds in the deficient areas of South Africa, the disease 'lamsiekte,' which a dozen years ago, caused enormous losses, ing those areas has again become profitable. The significant fact may be recorded here that the village of Vryburg in Bechuanaland, where ten years ago milk was very scarce, to-day owns a creamery which handles a larger volume of cream than any other creamery in South Africa.

B.—OTHER VETERINARY PROBLEMS.

At the beginning of this paper mention was made of Dr. Gordon's presidential address in which the need for further research into problems of animals diseases, animal nutrition and animal breeding was emphasised.

,In regard to *animal diseases* the examples quoted in the preceding section show that considerable advance has been made during the years that lie immediately behind us. Many diseases have been conquered, but many others still await solution. Meanwhile these diseases cause enormous losses and even threaten the adequate supply of the world's markets with meat and other animal products.

Problems in connection with the *nutrition of animals* are now receiving attention in many countries. The vast importance of correct feeding can be illustrated best by referring again to the phosphorus deficiency which exists in the pastures of South Africa and other countries. The astounding results which have been achieved with the addition of a small quantity of phosphorus compounds to the ration of the animals promise to revolutionise the beef and dairy industries in those countries.

Animal breeding also presents problems of great importance and these are intimately bound up with the problems of disease and nutrition. In South Africa, as in other countries, there is a constant cry for the replacement of the scrub bull by pedigree sires. This demand would be met to a far greater extent, were it not for the fact that in many parts of the country pedigree bulls cannot live because of disease or nutritional difficulties. In some of the best ranching areas diseases like Heartwater, Piroplasmosis and Anaplasmosis render the introduction of susceptible animals quite impracticable, unless adequate measures for their protection be adopted. And, similarly, the deficient state of the pastures in other areas *nullifies all efforts at the improvement of* stock, unless the diet be supplemented.

It is pleasing to be able to record progress along both of these lines. In South Africa control over the diseases mentioned above is

deficient areas, recent investigations by Du Toit and Bisschop have shown that the gradinb up of native stock can be carried out with complete success provided the deficient mineral is supplied. Both beef cattle and dairy cattle have been bred on the extremely deficient veld of Bechuanaland without any signs of deterioration, and the cost of the supplementary ration has heen negligible in comparison with the material advantage derived from such feeding.

Gratifying though the success which has been achieved may be, the need for further research on live stock problems has never been greater than it is to-day. The development of enormous areas in the British Dominions and Colonies is entirely dependent on the progress of research. With the aid of further scientific measures, these new countries could absorb a very much larger population than they now harbour. The danger of over-population will not make itself felt for generations, nor need the danger of over-production be contemplated seriously. The shortage which has been predicted in the British beef market will have to be met by the Dominions and Colonies. The same applies to the mutton market. And in regard to wool it seems certain that the existing depression is temporary, and that, as soon as the present fashions alter, regrettable though such a change may be from other points of view, the wool trade will be restored to its previous healthy state.

The prosperity of a very large percentage of the population, both European and Native, in the Dominions and Colonies depends on the live stock industry (breeding of pedigree stock; beef, mutton or pork production; dairy farming, wool or mohair production; skin and hide trade; poultry farming, &c.). These farmers look to the Veterinary Service of their countries more and more for assistance and protection. Without this assistance profitable stock farming, especially in the tropical and subtropical countries, is impossible. The assistance, if it is to be effective, must be based on the latest achievements of scientific research. Rule-of-thumb methods will not suffice. There are fundamental problems which can only be studied at specially equipped institutes; and this is now being done. But, in addition, each country has its own particular problems which it must solve for itself at its own research institutions. Wise governments will support these

ON THE CELLULOSES FROM DIFERENT NATURAL SOURCES. II

By Naohiko Matsunami.

The bleached celluloses and the mercerised celluloses from three different sources, ramie, Todomatsu and Kaoliang, are determined, from the experimental results related in Report I, to be different from each other in their physical and chemical properties, and the difference between these celluloses, which is shown in the viscosity of their cuproammonium solutions, their alkali-adsorption and the effect on them of the action of super-heated water, is dependent in part at least upon the difference in the chemical composition of these celluloses. The presence of lignin or hemicellulose in the cellulose fibres depends chiefly upon the methods by which the celluloses are prepared and purified, and the occurrence of some degradation products such as oxydised cellulose in the celluloses may be attributed to the chemical nature of the α-celluloses, since, in order that the fibres examined should be as nearly comparable with each other as possible, they were subjected to a uniform procedure in the preparation of the bleached celluloses and in their treatment. For the purpose of the present study, pure α-cellulose is required. For elimination of the non-cellulose constituents from bleached ramie and wood cellulose, they were treated with 12.5 per cent. and 4 per cent. caustic soda solution. By this means, α-cellulose of high purity was obtained with 5.9 per cent. loss of weight. Bleached Kaoliang cellulose was treated with 4 per cent., 12.5 per cent., and 17.5 per cent. caustic soda solutions in succession to eliminate the non-cellulose component, and the yield of α-cellulose was about 84 per cent.

The purity of these celluloses is about the same in each sample, and they show similar behaviour towards dyestuffs and strong alkali solutions, and also similar results with regard to the specific viscosity and the specific rotatory power and the hydrolytic velocity. It is noted that the Kailiang α-cellulose, which consists of 99 per cent. of α-cellulose, is especially marked in its resistance to the action of oxidising and hydrolytic agents.

The α-cellulose obtained from the different sources were undoubtedly suffered in a marked degree from some changes during the mercerisation. A proof for the view that α-celluloses undergo partly a chemical change by mercerisation is noticed in the

The main difference among the celluloses from wood pulp, ramie and Kaoliang is in the resistance to hydrolysis and oxidation, which seems independent of the presence of the furfural-yielding residue left in the pulp even after severe cooking and bleaching treatments. A small quantity of the furfural-yielding substances remains in the Kaoliang pulp, which is unaffected by bleaching, and those substances are far less than the loss of α-cellulose by the action of superheated water. Kaoliang cellulose especially therefore is greatly affected by this treatment being converted into a soluble substance.

Thus, α-celluloses from three different sources show quite different behaviour toward superheated water notwithstanding that they contain the same quantity of the major characteristic constituent of α-cellulose (99.5-99.8 per cent.).

The attempt to prove that purified celluloses are chemically identical therefore fails since α-celluloses differ in their resistance against the action of superheated water. It is not determined whether the difference in the chemical reaction of α-celluloses to superheated water is to be attributed to a difference in the mode of aggregation or combining way of the chemical unit $C_6H_{10}O_5$ in the molecule or to a difference in the configuration of the atomic groups in the unit.

MERCHANDISE MARKS ENQUIRY.

The Standing Committee appointed by the Board of Trade, will hold an enquiry at 11.30 a.m., on Monday, 6th October, and at 10.30 a.m. on Tuesday, 7th October, as to whether imported Fertilisers or Feeding Stuffs of the following descriptions :—

(a) Bone meal and bone flour, whether raw, degreased or degelatinised;
(b) Hoof meal, horn meal and mixtures thereof;
(c) Meat meal, meat and bone meal and carcase meal;
(d) Dried blood, whether ground or unground;

should be required to bear an indication of origin.

The enquiry will be held at the Board of Trade Offices, Great George Street, London, S.W.1. Communications should be addressed to the Secretary, Mr. E. W. Reardon, at that address.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

Centenary Fund.

On the occasion of the Centenary of its foundation, which will be celebrated in London in 1931 (September 23-30), the British Association aims at raising a fund which not only will cover all necessary and desirable expenditure in connection with the Centenary Meeting, but also will assure for the future an adequate financial basis upon which to develop its approved activities.

The total sum which is the Association's objective is £40,000.

During the century of its existence the Association has striven—

To extend general interest in Science and its applications.

To promote intercourse between those engaged in scientific work in all its branches.

To initiate and encourage scientific research.

These objects have been achieved—

By holding Annual Meetings in principal cities of the United Kingdom and in the Dominions, and in various other ways.

In 1928 the Association received the Royal Charter of Incorporation.

In 1929 the Association, through the liberality of Mr. George Buckston Browne, F.R.C.S., came into possession of Down House, the Kentish home of Charles Darwin, which was vested in the Association by the donor in custody for the nation, and is maintained as a memorial. Thereby was discovered a new and unforeseen, but wholly appropriate, extension of the Association's responsibility and work.

Income and Expenditure.

The funds of the Association available for general purposes consist of—

Membership subscriptions: Averaging annually £2,500.

Interest from an invested capital of £8,000 accumulated mainly from general income during earlier years, and more recently from life compositions.

Interest from a gift of £10,000 by the Hon. Sir Charles Parsons.

A gift of £10,000 by Sir Alfred Yarrow, provided by him to be expended as to both interest and capital during a term of years ending not later than 1948.

The Association also administers funds amounting to £10,000, provided mainly by the late Sir James Caird and the late Lt.-Col. Alan Cunningham, applicable specifically to the financial assistance of researches, and £20,000 provided by Mr. Buckston Browne as a capital sum, of which the interest is to be devoted to the maintenance costs of Down House.

The average income and working expenditure of the British Association fall accordingly under the following main heads :—

Income.

	£
Membership subscriptions	2,500
Dividends and Yarrow Endowment	2,300
Sale of publications, advertisements, etc.	800
	£5,600

Expenditure.

	£
Printing	1,700
Salaries and Wages	1,700
Office, travelling expenses etc.	750
	£4,150

SUMMARY.

In summary the Association is seeking the proposed substantial addition to its endowment in order that it may—

Meet the expenditure appropriate to the fitting celebration of it Centenary, and thereafter—

Maintain and extend its activities for the advancement of science, and especially—

- Maintain and extend its support of research,
- Properly discharge its national trusteeship of Down House,
- Make itself a more effective agent of publication,
- Prove a less exacting guest in the localities of its meetings,
- Assure the means of carrying out its Imperial responsibilities,
- Extend its facilities for junior students of science.

It has been stated that ' to voluntary service in the interests of science the whole record of the British Association stands as one great memorial.' The object of the present appeal is to strengthen the organisation which makes use of that service.

Contributions may be addressed to, and will be gratefully acknowledged by, the

HIGHLY POLYMERISED COMPOUNDS. THE CONSTITUTION OF POLYINDENE.

By H. STAUDINGER, AVERY A. ASHDOWN, M. BRUNNER, H. A. BRUSON AND J. WEHRLI.

The polymerisation of the hydrocarbon, indene, has been known for over thirty years, but the chemical structure of the polyindene had never been determined. This study forms a part of Professor Staudinger's program of investigation of highly polymerised compounds. The work was done in the chemical laboratory of the Technische Hochschule in Zürich while one of the junior authors (A. A. A.) was Moore Fellow 1924-1925.

Indene is readily polymerised by many different catalysts such as sulphuric acid, iodine, certain metallic salts and Florida earth. The best of these agents are tin tetrachloride, titanium tetrachloride, boron trichloride, antimony pentachloride and antimony trichloride. In the work reported here, tin tetrachloride was used chiefly in preparing the polymers. Whatever the catalyst, however, only hemicolloids are formed, in distinction from styrene which yields both hemicolloids and eucolloids.

The polymerisation was carried out in benzene or chloroform solutions. Dilution favours the formation of products of relatively low molecular weight. High temperature likewise leads to polymers of comparatively low molecular weight. The average molecular weights, cryoscopic in benzene, of the different fractions of the polyindene vary from 1500 to 6000.

These fractions were obtained by extraction, or by partial precipitation in certain cases, with ether, petroleum ether, and cyclohexane. The properties of the fractions showed that polyindene is a mixture of many homologous polymers. The least soluble fractions have the lowest molecular weights, the lowest melting points, and their solutions are the least viscous. These relationships hold for polymers generally and not simply for polyindene.

The structure of the polyindene was studied from three points of view. First, the ends of the long chains might be saturated by groups such as hydroxyl, methoxyl,, or acid residues, as in the case with

Second, there might be double bonds at the ends of the chains. However, no reactions characteristic of such bonds could be found.

Third, the final conclusion was that indene in polymerising forms very large rings just as does α-methyl styrene. Such large rings have been shown to exist in other cases, *e.g.*, the cyclic ketones of Ruzicka. Unfortunately, the di, tri, and tetra indenes could not be isolated from the polymeric mixture, thus leaving a blank in the chain of evidence. It seems likely that at least eight or ten individual molecules join together before ring closing occurs. That the primary valence forces were operating is borne out by the stability of the polymer at temperatures as high as 150 degrees Centigrade and by the constancy of molecular weights over a wide range of concentrations.

Every effort to obtain in crystalline fractions from the polyindene failed. In other words, for polyindene the structure is such that a regular crystal lattice is not formed. In this respect these polymers differ markedly from the crystalline rubber of Pummerer and the crystalline cellulose acetate of Hess.

HIGH TEMPERATURE SUPERHEATING.

Another Example in London.

By A Well-Known Engineer.

The fact that 750°-850° F. is now becoming standard practice for superheated steam in power plant operation, very interesting also from the chemical engineering point of view in connection with hydrogenation and oil cracking, for example, is illustrated by the Millfields Road Station of the Hackney Metropolitan Borough Council which is being extended by the addition of two 30,000 K.W. turbo-generators and six boilers.

For the first half of this equipment, that is, one turbo-generator and three boilers, the main contractors for the steam plant are Messrs. Simon-Carves, Ltd., Manchester. The boilers, of the semi vertical, tri-drum type, will each have a normal evaporation of 125,000 lbs. per hour, and 150,000 lbs. maximum, operating at 400 lbs. pressure and 800° F. superheated steam temperature, that is 360° F. of superheat. The firing is by "Underfeed Type L" travelling grate stokers, and the superheaters are of the "M.L.S." single-pass multiple-loop, intertube type, designed and constructed by the Superheater Co., Ltd., of London.

There are already many other high temperature steam boiler plants operating or under construction in Great Britain with this type of superheater, the following being some notable examples :— Walsall, West Midland Joint Electricity Authority (760° F.); Hull Corporation (755° F.); Leicester Corporation (760° F.); Leeds Corporation, Kirkstall Station (750° F.); Barking, County of London Electricity Supply (765° F.); Scarborough Corporation (750° F.); Sheffield Corporation (800° F.); Neasden, Metropolitan Railway (750° F.); and particularly Synthetic Ammonia and Nitrates, Ltd. (855° F.) at Billingham, the latter being one of the most remarkable industrial steam and power plants in the world.

In the "M.L.S." superheater the essential feature is the employment of the single-pass principle in which a series of long multiple-loop elements, of comparatively small diameter, are connected in parallel between the saturated and superheated steam headers. This results in uniform steam distribution at all ratings, with high velocity and consequent freedom from local over-heating, the single pass elements being made to give any desired length of steam travel by uniting the necessary number of tube lengths by integral forged return bends, which are stronger than the tube itself. This method of construction is claimed to be superior to any system of oxyacetylene or electric welding, in which a smooth uniform internal tube surface at the weld cannot always be ensured.

Another valuable feature also is the flexibility in design made possible by multiple-loop construction, the superheater being easily adaptable to almost any conditions of space, operating pressures and temperatures, and methods of firing.

These improvements in design and construction have made it possible to use low carbon steel superheater elements for temperatures up to about 850° F. or slightly over, so that 750° F. is now no longer regarded as the maximum temperature permissible without using extremely costly alloy steel elements tubing, a matter of considerable importance also for many chemical operations including for example distillation and oil cracking.

GENERAL NOTES

ENGLISH CHEMICAL STATIONS.

In the more important seaports chemical stations have been established for the purpose of testing samples of imported chemicals. The work at these stations is performed mainly by Customs and Excise officers, trained for the purpose at the central laboratories.

The Liverpool Station is in charge of three chemists drafted from the general staff and is in close touch with head-quarters. The work at this station has been extended to embrace classes of samples not dealt with at other chemical stations. The senior chemist at Liverpool also supervises the Manchester chemical station.

The Chemical station at the London Dock forms part of the Custom House Laboratory organisation and is in charge of the Superintending Chemist of that Laboratory.

The remaining chemical stations are under the general supervision of a member of the chemical staff of the Central Laboratory, who visits them periodically. As a further check on the work the residues from a certain number of samples tested at the chemical station are retested at one of the Central Laboratories or at Liverpool. The number of retests during the year 1930 was 842. The results indicate that the work at the chemical stations is performed in a highly efficient manner.

BOARD OF TRADE ANNOUNCEMENT.

Licences in September, 1930.

The following statement relating to applications for licences under the Dyestuffs (Import Regulation) Act, 1920, made during September has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee.

The total number of applications received during the month was 507, of which 458 were from merchants or importers. To these should be added 28 cases outstanding on the 30th August, 1930, making a total for the month of 535. These were dealt with as follows :—

Granted—512 (of which 481 were dealt with within 7 days of receipt).

Refused—17 (of which 15 were dealt with within 7 days of receipt).

Outstanding on 30th September—6.

Of the total of 535 applications received, 496 or 9 per cent. were dealt with within 7 days of receipt.

CANADA'S COBALT PRODUCTION.

According to the Dominion Bureau of Statistics at Ottawa, the production of cobalt in Canada in 1929 amounted to 929,415 pounds valued at $1,801,915, as against 956,590 pounds, valued at $1,672,320 in 1928.

Production included the cobalt content of the various cobalt products sold by the Deloro Smelting and Refining Company, Ltd., which company treats the greater portion of the silver-cobalt ores of Ontario, and the cobalt content of ores and residues exported for treatment in foreign smelters; the value reported is the net amount received by the shippers.

In addition to the exports from Ontario a small shipment of ore containing gold, arsenic and cobalt was made in 1928 from British Columbia to Australia.

Cobalt is used in the form of oxide as a pigment in the manufacture of earthenware, porcelain and enamelware; the addition of cobalt oxide produces the well-known " cobalt blue " colour. It is also used in the manufacture of driers for the paint and varnish industry.

Cobalt metal is chiefly used in the manufacture of " stellite," a cobalt-chromium-tungsten alloy used in making cutting tools for high-speed lathe operations.

PETROLEUM PRODUCTION FROM NOVA SCOTIA OIL SHALE.

On July 4th the first unit of the plant of Torbanite Products, Ltd., was brought into operation at New Glasgow, N.S. Preparations for the recovery of petroleum from Nova Scotia oil shales have been going on at New Glasgow for the past two of three years, and the Company named has installed a plant having a capacity for handling 50 tons daily. The present installation is an initial unit only, but others are expected to be added at a later date. The Company holds oil shale deposits covering an area of more than 1,400 acres, but in Nova Scotia there are stated to be hundreds of thousands of acres of similar deposits. The Company's holdings are stated to contain at least

THE DYESTUFFS ACT.

The Association of British Chemical Manufacturers has just issued a pamphlet, *The Dyestuffs Act*, which expresses the views of the chemical industry in connection with the working of the Act and the desirability of its prolongation for another period.

GOVERNMENT CHEMIST'S REPORT.

The *Report* of the Government Chemist upon the work of the Government Laboratory for the year ending 31st March, 1930, has been published by H.M. Stationery Office, Adastral House, Kingsway, price 9d. The chemical work of the Admiralty, Ministry of Agriculture and Fisheries, Air Ministry, Colonial Office, Board of Customs and Excise, Ministry of Health, Post Office, Ministry of Pensions, Board of Trade, War Office, and Office of Works is done either wholly or in part by the Government Laboratory, which also renders reserved services to certain colonial institutes.

There has been an increase in the number of samples examined, and these have been drawn from the widest possible range of materials and products. The *Report* makes reference to the scientific communications to various journals by members of the staff.

ROUND THE WORLD WITH THE RED CROSS.

Make a Healthier Empire.

Imperial Conference and Its Results.

A vivid impression of the vast achievements of the Red Cross in " the improvement of health, the prevention of disease and the mitigation of suffering " throughout the Empire is contained in the official report of the first British Empire Red Cross Conference, issned recently.

Since the war, as most people know, the Red Cross has supplemented its primary work of helping the sick and wounded in time of war by directing the energy of its great army of voluntary workers into peacetime channels. In this country that energy is expressed in the Society's ambulance and first-aid service on the roads, at race meetings, fairs and exhibitions—wherever, in fact it is likely to be needed; in the provision of medical supplies and hospital libraries; in hospital and home nursing; in the administration of orthopaedic clinics, children's welfare and school treatment centres and day nurseries; in the establishment of a magnificent research and treatment clinic for rheumatism; in the finest blood transfusion service in the world, and in general health education, by means of travelling lecturers.

Throughout the Empire, similar work, adapted to meet local conditions, is now carried on.

Dominion Needs.

In Canada, for example, the Red Cross runs fifty-four Outpost Hospitals, providing medical and nursing care for poineer settlers in the districts to which ordinary hospitals have not yet penetrated.

On of Australia's greatest problems is tuberculosis, and this the Red Cross has sent out to combat. It has established seven sanatoria and convalescent homes throughout the Commonwealth for the treatment of ex-soldier and civilian patients and their families.

Child Welfare in India.

In India, with its millions of illiterate village dwellers, and its enormous infant mortality, child welfare has been put in the forefront of the Red Cross programme. More than 200 child welfare centres have been opened.

Inoculation.

The devasting floods with which certain areas of India are visited every year have given the Red Cross a further opportunity for service. In the great Assam flood last year the Red Cross inoculated 50,000 persons, with the result that an outbreak of cholera was prevented, while the Punjab branch alone raised three and a quarter milion rupees for flood relief work.

New Zealand's health needs are so similar to those of Great Britain that there the Red Cross work is practically the same, and organises V.A.D. detachments for service in epidemics and disasters.

The South African Red Cross has developed an extensive scheme for the instruction in First Aid both of Europeans and natives working in the Transvaal mines. Health vans tour the Kaffir villages giving lectures, while the First Aid dressing stations are set up at important centres. Special campaigns are conducted against malaria, bilharzia and tuberculosis.

FOSSIL TREASURES.

Mr. Roy C. Andrews, leader of the Gobi Desert Exhibition organised by the American Museum of Natural History, and Mr. Walter Crainger, Chief Palaeontologist, have returned to Peking on completion of their work for the present year.

They announce that they have the largest collection of fossils of prehistoric animal life unearthed since 1922. The explorers declare that this has been scientifically a record year.

OIL AND GAS RESOURCES OF THE PROVINCE OF QUEBEC.

The Province of Quebec has not hitherto been regarded as a probable source of petroleum or natural gas and has produced up to the present no fuel of any kind with the exception of wood and peat. It has nevertheless often been considered that the St. Lawrence lowlands, in common with certain areas in southern Ontario, might contain promising locations for drilling operations with the object of discovering sources of petroleum or natural gas.

Petroleum is known to occur in the Gaspe Peninsula where many wells were drilled with indifferent results thirty or more years ago, and natural gas occurs at many places in the St. Lawrence lowlands between Montreal and Quebec, and as far south as St. Hyacinthe. Bituminous shales and sands, furthermore, are known in Gaspe and at Port Daniel in the St. Lawrence lowlands, as well as near Chicoutimi in the vicinity of Lake St. John.

One of the first investigations, therefore, to be undertaken by the recently enlarged staff of the Quebec Geological Survey was an enquiry into the oil and natural gas resources of the Province, and part B of the Annual Report of the Quebec Bureau of Mines, 1929, just published, presents the facts which have been collected by Professor Wm. A. Parks on behalf of the Provincial Government. The Report in question contains 5 chapters illustrated by three maps. Chapter II deals with petroleum in the Gaspe Peninsula; Chapter III with petroleum in the Trenton limestone. Bituminous shales and sandstones are discussed in Chapter IV; and in Chapter V the outstanding facts are given relative to natural gas.

Proceedings and Notices of Societies

THE PHYSICAL SOCIETY.

October 17.

The following papers were read :—

A Simple Approximate Theory of the Pressure Between Two Bodies in Contact. By J. P. Andrews, M.Sc., F.Inst.P.

When two solid bodies are pressed together without at any point exceeding the elastic limit, their common area of contact is frequently circular, and in such cases the normal stress at each point of this area may be calculated by a simple approximate method giving results correct, as a rule, to within 1 or 2 per cent. The approximation makes use of two principles : (*a*) The displacement at the centre of the circle of contact is twice that at its edge, and (*b*) for the purpose of calculating the stresses we may replace the two bodies by a single sphere of which the circle of contact is a diametral section, and write the strain at any point as the ratio of the displacement of that point to the length of the line drawn from the point to the sphere in the direction of displacement. When the elastic modulus with which this is multiplied is taken as that appropriate to a rod with sides fixed, the agreement with accurate theory is close. It is shown that the principle (*a*) remains nearly true for elliptical areas of contact.

Experiments on Impact. By J. P. Andrews, M.Sc., F.Inst.P.

This paper, which describes the continuation of a research upon the impact of soft metallic bodies, contains the results of four investigations, as follows : (1) Impact of equal spheres for low values of the velocity of approach v. The duration of contact is found to vary inversely as $v^{\frac{1}{5}}$, while the coefficients of restitution e in the same cases are found to be unity for all speeds below a value characteristic of each material, as though the metals were perfectly elastic for smaller speeds. (2) The effect of duration of contact upon the size of the permanent deformations. No effect was observed. (3) The variation of duration of contact t, with mass of sphere at high speeds of approach. Within the limits of experimental error, t varies as the square root of the mass, as theory predicts. (4) The impact of crossed cylinders. No important new phenomena are found.

Observations on Percussion Figures. By J. P. ANDREWS, M.Sc., F.Inst.P.

The formation of percussion figures by the pressure of a steel ball on glass blocks is here traced out, and an investigation suggested by this exploration elicits the following facts : (1) The diameter of the innermost circular or part-circular crack remains constant for one specimen of glass, and is independent of the maximum pressure exerted by the ball on the glass. (2) The diameter of the outermost circular or part-circular track varies with the maximum pressure in a manner which suggests that the crack tends to keep to the outer edge of the area of contact. (3) No crack is formed until the pressure exceeds a value characteristic of the glass. A method of testing the fragility of glass is developed : and finally some observations on percussion figures upon spherical surfaces are mentioned.

Some Physical Radiometric Investigations of Technical Interest. By DR. RYDOLF HASE.

THE INSTITUTION OF PETROLEUM TECHNOLOGISTS.

October 14.

Experiments to Determine Velocities of Flame Propagation in a Side Valve Petrol Engine. By H. S. GLYDE, B.Sc., A.M.I.C.E.

PURPOSE OF THE EXPERIMENTS.

The following experiments were made by the writer to determine the velocity of flame travel in an internal-combustion engine of the side-valve poppet type. Tests were carried out on a conventional type of head to investigate flame velocities in a combustion chamber in which the degree of turbulence was relatively low In addition, measurements were taken for combustion chambers of the Ricardo turbulent type having three different head clearances.

In the Ricardo type of combustion chamber the head clearance had a marked and critical effect on detonation. The curve of H.U.C. ratio plotted against head clearance showed a very abrupt change in characteristic at a head clearance of approx. 0.14 in. Below a certain clearance the surface volume ratio of the gas trapped above the piston became great enough to militate against self-ignition and the occurrence of detonation.

It has been found that the greater the degree of turbulence, the greater both the mean and the maximum velocity of flame travel across the combustion-chamber. Velocity of flame travel is almost proportional to the degree of turbulence as measured by rate of pressure rise on the explosion line of the pressure diagram. It should be noted that this conclusion applies only to heads having the same general form, and in which all variables are kept as nearly as possible the same with the exception of the degree of turbulence in the combustion-chamber.

The velocity of flame propagation is at first quite slow. After reaching a distance of 1.55 in. the velocity increases rapidly to its maximum value at a distance of 2.7 in. The velocity subsequently falls quickly until the further wall of the combustion-chamber is reached. The rapid diminution in velocity would appear to be due to the head clearance, the falling off in velocity after the maximum value is reached is much more gradual.

Whatever the degree of turbulence, the time at which maximum velocity occurs, when the time of occurrence of the spark is adjusted to give the best results, falls within a range of 3° of the crankshaft. This statement applies to 4 heads, of which the range of turbulence extended from 23 to 59 lb. per sq. in. per degree rate of pressure rise.

The velocity with which the flame spreads from the nucleus is nearly proportional to the degree of turbulence as measured by rate of pressure rise. This was an unexpected feature of the results, as it was thought that the rate of flame propagation in the initial stage of combustion would have been more or less constant over a wide range of turbulence on the assumption that at first when the flame nucleus is in process of development, the spread of flame would not be dependent on the degree of turbulence, but on the strength of mixture surrounding the sparking-plug points.

The total time for the flame to traverse the full distance from the sparking plug to the opposite side of the piston is also nearly proportional to the rate of pressure rise.

Broadly speaking, for combustion-chambers of the Ricardo Turbulent type, with a rate of pressure rise of from 30-40 lb. per sq. in. per degree (the degree of turbulence usually employed in practice), the flame velocity may be said to be of the order of 80 ft. per second initially, rising to 300 ft. per sec. during the combustion process. The period occupied by the process of combustion process. The period occupied by the process of combustion corresponding to these velocities is about 25° angular movement of the crank shaft.

NOTICES OF BOOKS.

The Patents, Designs, and Trade Marks Act. By H. F. Moulton and J. H. Evans-Jackson. Pp. 197. London: Butterworth & Co., Ltd., Bell Yard, Temple Bar. 1930. Price 21s. net.

The never ceasing flow of cases relating to Patents and Trade Marks renders it essential that those who practise in these subjects should be provided in convenient form with guides to the more recent decisions of the courts, a need which is emphasised by the circumstance that so great a proportion of the argument and judgments in these causes is concerned with facts relevant only to the particular case, often rendering it difficult to extract those points of law which may be of general importance.

The 1929 edition on Patents, Designs and Trade Marks Act by the same authors, has long been exhausted, and in response to many requests for a re-issue, the present edition has been prepared.

This contains notes of the salient points of all decisions during the last seventeen years, also the text of the present statutes with notes. For the convenience of practitioners the corresponding sections of the Patents and Designs Act, 1907, and of the Trade Marks Act of 1905, are also given, thus enabling the alterations to be seen at a glance.

A special feature of this book is a collection of extracts from a large number of decisions that have been given by the Comptroller-General or his deputies. These decisions are of great importance as they regulate the practice of the Patent Office. This is the first time their effect has been submitted to the public and should greatly facilitate patent agents both at home and abroad in their work.

KELLY'S DIRECTORY OF THE CHEMICAL INDUSTRIES, 1930.

We have received the 1930 edition of the above valuable reference book, which has just been published. Pp. xxx + 1075 + xxviii. Price 80s. London: Kelly's Directories Limited, 186, Strand, W.C.2.

This directory which embraces England, Scotland, and Wales, contains the names of those engaged in many branches of the chemical industries, both the manufacturing and the selling sides being adequately dealt with.

It would be impossible to give the name of each industry with which this directory deals but the following headings (selected from a total of some eight hundred) should give an indication of the wide scope of the information supplied :— Chemists and Druggists; Bottle Manufacturers; Chemical Manufacturers; (more than 90 separate headings); Chiropodists; Dentists; Hospitals and Dispensaries; Opticians; Patent Medicine Vendors; Perfumers; All branches of the Photographic Trades; Mineral and Soda Water Manufacturers; Veterinary Surgeons; &c., &c.

The book comprises :—

1. A places section, giving names for each county, arranged alphabetically under the towns and villages.
2. An Alphabetical classification of trades for the London postal district, arranged with the names under each trade heading in alphabetical order.
3. A similar classification of trades, for the rest of England, Scotland, and Wales.

There is also an alphabetical list of some 1,000 branded articles and specialties used in the chemical industries, together with the names and addresses of the manufacturers.

A WORLD TELEPHONE DIRECTORY.

The second edition of the Annuaire Telephonique Internationale (Ati for short) has just been published and it certainly shows a remarkable growth compared with the first edition.

The first edition published in 1929 contained about 12,000 entries from 1485 towns in 27 different countries, while the second edition contains the names of more than 50,000 firms from 3718 towns in 38 countries which is a strong indication that it is well on the way to become a world telephone directory.

The first edition was published only in three languages, but on account of the widespread interest it caused in practically every country it has been found necessary to include Spanish also, the second edition is therefore printed in English, French, German, and Spanish.

"Ati" is much more than an international telephone directory. it is also, on account of its varied contents compiled from various countries, giving reference to business firms only—the most-up-to-date international reference book and Trade Guide as far as international business is concerned that has yet been compiled.

All business men interested in international trade should not only procure a copy.

but also have their names and the nature of their business inserted in this valuable book.

For full particulars apply to the official representatives in this country :—Messrs. Rassey Bros., Bevois House, 28, Bassinghall Street, London, E.C.2.

Economic Conditions in Japan. By G. B. SANSOM, C.M.G., AND H. A. MACRAE, M.A. Pp. 97. London : His Majesty's Stationery Office, Adastral House, Kingsway, W.C. (Issued by the Department of Overseas Trade). 1930. Price 2s. 6d.

The Report discusses the effect on trade conditions resulting directly from the action of the new Japanese Ministry in raising the gold embargo in January, 1930, and of the efforts of the Government to reduce Government expenditure and enforce a limitation of imports.

The main Japanese exports have encountered unfavourable conditions in their chief markets. Over 80 per cent. of Japan's exports go to the United States and Asiatic countries. The general trade depression is due chiefly to the financial crises in the States, the disturbed conditions in China, and tariff increases in India. The economic position is therefore discouraging, but cannot be attributed to any weakness in the financial or industrial organisation.

Considerable information is given in the section relating to exports as to the condition prevailing in the Japanese industries, and particularly as regards silk and cotton, and the output of the chemical and electrochemical industry which has increased immensely owing to the development of the hydro-electric industry.

The report goes on to describe Japan's trade with Great Britain which shows a decrease in 1929 as compared with 1928. Reports dealing with trade in Formosa and Corea are printed as appendexes to the main report.

Forthcoming Events.

THE PHYSICAL SOCIETY AND THE OPTICAL SOCIETY.

TWENTY-FIRST ANNUAL EXHIBITION.

The Twenty-First Annual Exhibition of Electrical, Optical and other Physical Apparatus is to be held by the Physical Society and the Optical Society on January 6, 7, and 8, 1931, at the Imperial College of Science and Technology, South Kensington.

The Research and Experimental Section will be arranged in three groups :—

(a) Exhibits illustrating the results of recent physical research.

(b) Lecture experiments in Physics.

(c) Historical exhibits in Physics.

The Exhibition Committee invites offers, from Research Laboratories and Institutions and from individual research workers, of exhibits suitable for inclusion in any of the above three groups. Accommodation for these exhibits will be provided in rooms separate from those devoted to the trade exhibits; and a part of the Catalogue will be devoted to their description. No charge will be made for space or catalogue entries in the Research and Experimental Section. Offers of exhibits, giving particulars of space and other facilities required, should be communicated immediately, and in any case not later than October 30 to the Secretary, Exhibition Committee, 1, Lowther Gardens, Exhibition Road, London, S.W.7.

THE INSTITUTE OF METALS.

SWANSEA LOCAL SECTION.

Tuesday, October 28th, at 6.15 at the Y.M.C.A. "Impurities of Copper." By Dr. Rosenhain.

ROYAL INSTITUTION.

21, Albemarle Street, W.1.

Tuesday, November 4, II. at 5.15 p.m. New Aspects of Radioactivity. By C. D. Ellis, Ph.D., F.R.S., Fellow of Trinity College, Cambridge.

THE INSTITUTE OF BREWING.

HORACE BROWN MEMORIAL LECTURE.

Friday, 21st November, 1930.

The Horace Brown Medal is awarded by the Council for "eminent services on the scientific or technical side of the Fermentation Industries, at intervals of not less than three years."

The first award was made to Professor H. E. Armstrong, LL.D., F.R.S., in 1926, and the medal was presented to him on the occasion of the "Horace Brown Memorial Lecture."

The next recipient of the medal will be Dr. E. S. Beaven. The presentation will be made by the President (Mr. Percy Gates) in the Lecture Theatre of the Institution of Electrical Engineers, on Friday, November 21, 1930, at 8.15 p.m., when Dr. Beaven will deliver the Memorial Lecture.

The title of the Lecture is "The Culture of Barley for Brewing."

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

29,116.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of sulphuric acid esters of leuco-a-aminoanthraquinones. September 29.

29,117.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of sulphuric acid esters of leuco-aroylaminoanthraquinones. September 29.

Specifications Published.

335,596.—Wisconsin Alumni Research Foundation.—Producing lactic and acetic acids.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

DUROFUR.

514,719.—Chemical substances used in manufactures — British Dyestuffs Corporation, Ltd., Hexagon House, Blackley, Manchester. October 8. (Associated.)

ORTOXIN.

503,025.—Chemical substances for use in manufactures in sizing and finishing artificial silk.—I. G. Farbenindustrie Aktiengesellschaft, Mainzerlandstrasse 28, Frankfurt-on-Main, Germany. October 8. (By Consent.)

GRAMMAR OF LOGIC.

100 Questions and Answers on The Grammar of Logic or How to Reason Correctly. By J. E. Roscoe, M.A., Oxon.

An invaluable Book for all who desire to excel as speakers and who wish to reason *convincingly.*

Post free, 1/7.

CHEMICAL NEWS, LTD.,
Merton House, Salisbury Square,
London, E.C.4.

GENERAL INDEX TO THE "CHEMICAL NEWS"—VOLS. 1 TO 100.

This large Volume contains a detailed Index to the first 100 Volumes of the *Chemical News*, and will be found of great value to all interested in Chemical Engineering, Electrical and General Scientific subjects. It has been compiled with great care, is handsomely bound in red cloth, and has been produced at great expenditure of time, labour and money. Carriage paid, Great Britain, 21/- net; Carriage paid to Foreign Countries and the Colonies, 23/- net.

BRICK KILN PATENT FOR DISPOSAL.

Mr. V. Lastovicka, of the Japan and China Trading Co., 56, Rasin Embankment, Prague, Czechoslovakia, is open to receive offers for the exploitation of his patented "Tunnel" Brick Kiln Construction in Great Britain and Dominions and Colonies.

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THE CHEMICAL NEWS

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BRITISH PATENT.

It is desired to secure the full commercial development in the United Kingdom of British Patent No. 275,044, which relates to "METHOD OF PRODUCING CAUSTIC ALKALIES," either by way of Sale or the grant of Licences on reasonable terms.

For particulars apply PHILLIPS'S, 70, Chancery Lane, London, W.C.2.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

SECTION G.—ENGINEERING.

THE INTERDEPENDENCE OF SCIENCE AND ENGINEERING WITH SOME EXAMPLES.

By SIR ERNEST MOIR, Bart., M.Inst.C.E., M.Am.Soc.C.E., *President of the Section.*

INTRODUCTORY REMARKS.

As President of Section G I feel greatly honoured in addressing you after the many able men who have done so in the past. Many of my predecessors I have known personally and it is with hesitation I address you now, in view of my knowledge of the giants they were in their various walks of life. To name a few, Sir John Fowler, with whom, when little more than a boy of twenty, I frequently walked under the shadow of that great structure, the Forth Bridge, created in the mind of himself and Sir Benjamin Baker, whom I met more frequently and in closer friendship while I was in charge of the erection of his masterpiece. When I was twenty-two, I was placed by William Arrol in charge of the erection of the first portion of the Forth Bridge on its present site. Though Sir William Arrol never figured as your President, he was a man of fearless action and great foresight. He never doubted that any difficulty arising would be overcome, and he was never fearful of results and of his powers to succeed. John Fowler gave to his partner, Benjamin Baker, full credit for his great achievement in the design of the Forth Bridge, that was and is still his outstanding work, though many triumphs awaited him in later years. The great and lovable Frederick Bramwell, though not technically so supreme a master, his mind being rather of the judicial character as is shown in some of his arbitration awards, was another of those who have given you masterly addresses. Yet another is Sir John Wolfe Barry, with his broad mind and outlook, giving confidence to all who approached him, always showing a sense of fair play in his judgments between the companies whom he faithfully served, but never allowing them to influence his determinations between themselves and the contractors when they differed about their respective responsibilities for happenings entailing payments. This characteristic enabled him to get the work he designed carried out more cheaply,

since risks were less onerous under him than under many others practising during his active career. Next, Sir Douglas and Sir Francis Fox were a pair of brothers who left their mark on big undertakings, and Douglas was among those who have addressed you metaphorically from this rostrum. Alexander Kennedy is now only a memory, but what a memory and example he was to us all, and what a delightful and varied character he had! I had the great good fortune to study under him and under Vernon Harcourt, another great personality, for whom I acted as demonstrator in his surveying class at University College, London. His work was mostly to collect and collate in his books the works of others on harbours and docks—very useful work to those who come after. Alexander Binnie has also given you a masterly address on the ancient scientific lore of the Roman Lucretius, who appears to have known so much more about atomic theories and the basis of matter than was known for many generations after his time. Among those still living there are many who have done honour to the judgment of this Association and whose memory and achievements will leave their mark, and whose names will resound down the centuries. Prominent among these are Sir Charles Parsons, of turbine fame, and Sir Dugal Clark. To follow after such men and do justice in your judgment to the theme of the application of science to engineering, will be a great satisfaction to me, if I can fulfil the requirements, but it is with some misgiving, I repeat, that I attempt this task. It will be for you to judge whether I have succeeded when I have finished, and I hope you will bear with me in shortcomings if I do not live up to the high standard set by the men I have mentioned.

It has been my privilege and good fortune to have worked with and for many of those who have presided over Section G on some of the largest works during the last forty-eight years. You may gather from this that I began very young. Dr. Kirk was one of my early chiefs, the inventor of the block model for determining the resistance of ships. He also was the designer of the first triple expansion engine that propelled a ship to the Antipodes on a fuel consumption of 1.6 lbs. of coal per h.p. hour, and as an apprentice engineer, I worked upon her engines, both in the pattern and fitting shops. Here was an example of physical and [illegible] may have lagged behind the engineer in this case. During my apprenticeship in Glasgow, I got in touch with Lord Kelvin, or Sir William Thompson, as he was then. I conceived an idea for doing away with the piston rod in steam engines, much as is done to-day in the internal combustion engine as we all know it in the motor car, while at the same time closing the lower end of the cylinder so that a two-stroke scheme could be employed without having to put pressure in the crank casing. I made a rough model and took it up one evening, after my ten-hour day was finished, to show my idea to the famous man. I was told by the butler that Sir William had a dinner party so I hastily said I would call some other time. The butler insisted, however, that Sir William would be annoyed if he did not make me come in, so in spite of my protests I was ushered into the great scientist's study, and Sir William came in, having left his guests, and went through my idea critically for nearly an hour. I mention this to show what a great man Lord Kelvin was, quite apart from his inventive and scientific attainments, and kindly actions such as this no doubt encouraged every one who came in contact with him. What his dinner guests thought about it I do not know, but he did not seem to mind.

Some branches of engineering are more dependent on exact science than are others, but all must admit dependence on all or nearly all branches of science. I might say, on the other hand, that science in many of its branches has been helped, and urged forward to further investigations by the engineer stumbling on ground which science had not till then investigated, in the particular manner in which engineering had need. By collating results and making them applicable to the future needs of engineering, the scientific worker has on many occasions determined doubtful points and made the future use of discoveries and inventions by engineers and their allied workers possible. Thus engineering practice and engineering inventive imagination, and pure science have reacted on one another to the advancement of exactly applied knowledge. Simple facts and discoveries by scientific research workers have frequently not revealed their usefulness until those who apply them to the needs of men have tested them and shown their utility, and then the scientific investigator has made further advances, and indicated further possibilities in the use of

research worker or the engineer. My own experience, when dealing with practical civil engineering problems, has indicated some examples, and many doubtless exist unknown to me. The observatiou of natural phenomena has played a very important part in the advancement of science as applied to industry and to engineering problems of all kinds. The constructing engineer has not the time to investigate exactly the forces of nature with which he has to contend, and he has frequently to cover up his ignorance by the use of 'factors of safety' in making his designs, often using larger factors than are called for, and at other times not providing the necessary margins he thought he had allowed for. This is notably the case in connection with bridge designs and stresses arising out of the fatigue of metals and the hammer action of moving loads in bridge floor systems, and the effect of plunging rolling stock thereon. Investigations have been carried out recently by experiments on a large scale with actual locomotives, the results of which have been now collated by Prof. Inglis, of Cambridge, into some useful formulæ, from which computations of possible stresses may be foretold. Some types of locomotives have been so bad in this respect that but for our old friend, the factor of safety, the structures of many bridge floor systems would long since have been destroyed by percussion and repeated hammer blows dealt upon them. It was long recognised by engineers that the fatigue of metals under stress arising out of (1) the range of stress, and (2) its reversal, demanded lower maximum stresses to be applied, and the scientist has now so investigated the facts that positive data are available and results can be forecast with accuracy and certainty. Newton did not evolve the value of 'g' out of his own mind, but by observation its value was ultimately determined to the benefit of all who use physical science. I do not know how we should get along without 'g' now, though apples fell long before it was discovered, and it would be difficult to think how the influence of the planets upon our tides, so important to many branches of civil engineering work, could have been foretold but for the practical discoveries of Newton and their ultimate scientific consolidation into mathematical formulæ. There is still a great deal to be discovered in connection with the action of tides and waves and their destructive effect on sea works, many of which fail undoubtedly from the lack of exact knowledge of the sea shores where harbours must be built. Just recently we have had an example of the carrying away of years of work at Antofagasta Harbour, Chile, by a series of tidal waves. Yet there is no existing formula extant which would have enabled the civil engineer to forecast this appalling disaster. The influence of sea action on structures built up of units of mass and at varying depths of water is not at the moment governed by precise knowledge, and the forms of breakwaters vary the world over. There ought surely to be some means of collating data for the guidance of civil engineers in the design of marine works, which would save them from having to rely alone on the failures or successes of those who have gone before.

Voids.

The influence of air and water-filled voids and the effect they have on many matters that affect engineering practice is not, I think, fully realised.

Their bearing and their influence on design include within their range such widely different subjects as the solidity of breakwaters, their cost and their resistance to sea action; the combustion of fuels, both solid and liquid, and especially their rapidity of burning, ranging from explosions, in the case of propellants and blasting powders. to the corrosion of metals by oxidation. The minuteness of particles and the voids which surround them turn some innocent substances, such as coal-dust and flour-mill-dust, into dangerous explosives. and this is due to the intimate association of the air and its contained oxygen with the minute sub-division of their mass when they are powdered by grinding. The economy of fuel, both liquid and solid. when burning, is greatly enhanced by its fine sub-division, especially if provision for its intimate association with the atmosphere is arranged for. Explosion as compared with combustion is only a question of rapidity of combustion, the other extreme being the slow deterioration of metals due to oxidation as exemplified in the rusting of steel and iron structures. These examples show what a wide range there is in the phenomena that are in some measure attributable to the voids surrounding the particles of materials and their more or less intimate association with air.

I propose to give some examples later which have occurred in my own experience and which emphasise the question of the importance played by voids in engineering

Another aspect of this subject is exemplified in capillary attraction, or the capacity of certain mixtures of minute particles either in a loose form or in the form of porous solids, which have the power of defying the action of gravity by raising water. In some cases I have known water raised several feet, which seems to me to indicate the existence of a power that so far does not seem to me to have been adequately defined and has some analogy, I imagine, to the diffusion of gases. This power, possessed by some materials, which do not dissolve in water, of acting in an unexpected way on contained fluids, when such fluids are free to move by gravity to lower levels, is due to something not to my knowledge fully explained. I imagine capillary attraction may be analogous to the flow of sap in growing vegetation. It might be due, though I have never heard it suggested,, to changes of temperature that might produce this movement of vegetable fluids contrary to gravity. It is certainly not so in very fine sands formed of decomposed granites or in the porous structures of bricks and some rocks. I have known water rise np within a glass tube 1½ inches in diameter filled with fine sand, composed of decomposed granite (the lower end of which was immersed in a dish containing ½ inch of water) 6 or 7 feet in a few weeks. This, at first glance, might seem of little moment from a practical engineering point of view, but when subsoils having this characteristic have to be drained, so that trenches may be safely sunk therein, the effect of the included water on materials is a serious matter in the construction of engineering works. The lubricating effect set up by the water produces quicksands out of the very fine particles which, when dry, are relatively easy to handle by ordinary trenching methods. The included water makes a semi-fluid mass which becomes extraordinarily difficult to deal with in works involving excavation because the subsoil refuses to give up the water it contains, and will flow through slight crevices and under driven piling sunk into it many feet.

In connection with mixtures of concrete, voids play a very important part in the creation of what is practically artificial conglomerate. Further, the minimum size and the variety of sizes forming the inert parts of concrete mixtures make a great difference to the structure arising out of a mixture of sand and stone (commonly called 'the aggregate') with a varying amount of the cement particles themselves make a difference to the necessary hydration, which reunites them after their divorcement by heat and subsequent grinding to a very fine powder. In the case of air-tight or water-tight concrete it is a matter of great importance that all interstices be filled with cement when it has become hydrated. It forms the adhesive matrix between the other materials, which economise by dilution and form the greater part of the mass.

It is well known that an infinite number of different sized perfect spheres would ultimately create a mass with no voids at all, if their variety of size be carried to an impossible extreme. In many structures it is an ideal condition of things to get as near as may be practicable to this state of affairs when, as for example, an impervious concrete for dams and tanks is desired.

Doubtless many of you know what is commonly called the sand lime brick largely made in Switzerland from glacial moraine in the rivers, where stones of many different categories and sizes are brought down by the melting ice-fed rivers into the valleys. I have seen excellent bricks made in the Aar Valley out of a combination of a large number of different sizes down to minute particles of crushed stone in which the remaining voids wers so small that only 2½ per cent. of very finely ground lime to form the matrix was all that was needed to make what was practically an artificial solid stone. I have never heard of any other sand lime brick with such a minute amount of lime matrix producing this effect. All this points to the necessity of a minute analysis of sizes and shapes of particles to get the most economic use of lime or Portland cement in the making of a mass of artificial stone. Cement concrete differs only from masonry on general broad lines. Masonry, in the form of concrete, can be put in with the shovel, whereas hewn block masonry may involve lifting appliances and, in any event, very careful handling and setting to produce the desired results. It is, for example, much more difficult to make water-tight masonry than water-tight concrete, because it is more difficult to thoroughly fill the voids in the masonry joints with a trowel or by bedding the stones in mortar than by mixing the ingredients as in concrete.

Further, in earthen dams and in earthen railway embankments the question of settlement is very largely bound up with the amount of voids left in the material when it

During my work in the United States for the British Government during the war—1915-16—I had an interesting experience arising out of the testing of time fuses and the effects of voids thereon. The firm which had made many thonsands of this particular fuse—it was called a No. 185 time fuse—had been very accurate in their manufacture up to a point; the timing had been very regular and the percentages of error on proving at the range very small. Suddenly, however, the proving guns told another story, and the timing of the bursting of the shrapnel was distinctly bad. I visited the factory where these fuses were made and went minutely into the possible causes of the change. As to the chemical analysis of the powder, which was compressed into the time-burning rings, there was no change indicated in this analysis and no change in manufacture or in the pressing of it into the time ring. For a time we were all at a loss to account for what was happening. I remembered, however, that British Navy cordite made in England had holes cast through the blocks which go to form propellants for big gun charges. These were carefully proportioned to admit of association of the air surrounding such cast blocks (by perforation) in order to regulate the speed of combustion. I thought there must be something therefore changed in the volume of the voids and of the contained air arising out of the handling of the powder when in transit to the factory. I asked the head of the firm whether he had recently changed the method of transport. He said, 'Yes, we have. We have been making an addition to our factory, and while this has been going on we have had to bring the powder in by motor lorries over temporary roads instead of by railway wagon.' 'Well,' I said, 'I think this is the secret of the errors in the timing of the fuses you have made, for the powder has evidently been brought in over the rough roads made of tree trunks (called 'corduroy' roads in America), and has been more shaken than it had been when delivered by rail; the voids between the particles have been made less in consequence, and the included air is therefore less in amount, and contact with the particles of powder and the rate of burning is consequently different. This, then, is the possible cause of the burning in the time rings being irregular.'

To make a long story short, this was investigated and found to be the case, and when this rough motor transport was eliminated the same powder performed its proper function just as exactly as it had done before this temporary method of transport was introduced and without any change in composition or treatment in the manufacture of the fuses.

The breakwater I have just been constructing in Valparaiso Harbour, Chile, is founded in 187 feet of water upon a sandbank. This bank is deposited by suction dredgers from neighbouring foreshores within ten miles. It has spread out at its base to over a quarter of a mile in width, and the sand in its passing through this great depth of water has so consolidated itself as it falls upon the bed of the Pacific Ocean, and has so filtered out all its lighter particles on its way, that its consolidation has become very dense; so much so that the fluke of an anchor let fall upon it does not penetrate into its surface. This sandbank has been brought up to a depth below water of 63 feet and graded quarried rock is spread upon its top. Firstly, what is practically quarry rubbish of variable sizes weighing about 2 tons per m^3, from which has been picked the larger rubble, is spread on the top of the sandbank; then upon this quarry rubbish selected rock gradually increasing in dimensions as it gets nearer low water (which weighs about 1.7 ton per m^3) is placed. The quarry rubbish (or what is known in Chile as 'desmontes') is brought up to 66 feet below low water level, and thereon the larger categories of rock of 2 cwt. to $1\frac{1}{4}$ tons and from $1\frac{1}{4}$ tons to 10 tons in weight to 39ft. 6in. below water are placed. This upper layer, containing the larger categories, is deposited in excess to allow for settlement. It is levelled by divers, and upon this surface are placed blocks weighing 60 tons upon a slope of about 70° to the horizontal and at right angles to the axis of the breakwater, interlocked on the inclined face throughout their depth, so that they can slide down and take up any settlement in the bank on which they rest. Before the 60-ton blocks are placed, a period of one year is allowed to elapse so that the whole bank can settle. Notwithstanding this period of one year the great weight of the superstructure does cause further settlement extending over some months, resulting in a final settlement of about 8 feet.

None of the different categories of material appear to have been moved by the very heavy storms, locally known as 'northers' on the western coast of South America, neither have any tidal waves dis-

turbed or earthquakes moved, as far as we can determine, this enormous bank to any serious extent. There is evidence of two earthquakes having occurred before the breakwater was completed which caused some relatively small disturbance of the sandbank. The rubble was deposited in its various categories by hopper barges, and in its passage through the water there is little doubt that anything of an earthy nature that might have adhered to the rock was washed off. This has no doubt contributed to its solidity.

Valparaiso is the first large breakwater in which a sand foundation has been adopted to so large an extent, and there seems to be no doubt that in suitable situations, and in a sufficient depth of water, smaller material can be used for marine structures than has hitherto been employed. In shoal water, or near the low-water level, or where currents exist, sand should not be used. Small material may be satisfactory, however, at great depths, as evidenced in Valparaiso. Masses of sixty tons are needed on the Pacific Coast where, as on any coast, the vertical motion of the waves is converted by the shoaling bottom into a horizontal one. If local rock strata will not produce quarried rubble of sufficiently large categories, which is the case with a great many of the rocky formations on the Pacific Coast (due, no doubt, to earthquakes which are numerous) artificial concrete blocks are essential to produce the necessary masses.

Experience at Dover Harbour, and also at Valparaiso, indicates that below a level of forty-five feet, even in structures composed of practically vertical sides with the heavy seas beating thereon, nearly at right angles —there seems little chance of disturbance of relatively small stones.

It should be understood, however, in this connection that thought must be given to possible currents arising from any cause whatever. It is well known that stones of considerable dimensions are carried along our London sewers if a velocity of a few feet per second arises.

Only one small movement of the 60-ton blocks in Valparaiso breakwater occurred in an exceptionally heavy storm and that, I think, was attributable to an interesting and temporary modification of the top courses to assist construction. The movement was very small, and it adds to the interest to note, it was not on the sea side but on the sheltered side of the breakwater. It was attributable, I think, to the fact that a temporary longitudinal depression was left in the centre of the structure for construction purposes. The pier top has a total width of 45ft. 6in., and only the outer rows of blocks in the top course were placed. Thus a longitudinal channel protected from the sea in which to transmit the blocks, for construction purposes, to the crane at the outer end of the work was provided. This depression formed a canal when a heavy swell existed and was filled by the sea. None of the joints in the breakwater blocks are cemented or filled with grout, therefore, voids existed between them, into which columns of water flowed. Since water is incompressible, the falling masses of green sea on the surface of this filled canal acted like a hydraulic ram which transmitted vertical blows from the falling masses of fluid into horizontal pressure between the blocks. The blows moved the top courses of blocks towards the inside by a few inches but, fortunately, not sufficiently to require extensive demolition and replacement to put matters right. Had the storm continued for several days it is possible that these voids would have caused the partial destruction of the top courses of the breakwater. This canal was intended to be filled with mass concrete, and this has now been done, and no further trouble can arise from this cause.

Another and similar case occurred in the old Admiralty Pier at Dover, which is faced on both sides with granite blocks. A number of the blocks have been forced out at right angles to the axis of the breakwater by what was clearly equivalent action. In other words, the stone jointing was not full of cement and voids were left. Water accumulated behind the inner ends of these poorly jointed blocks, and the force of the hammer blows reacting from the almost vertical wall created what amounted to a hydraulic ram and so forced the granite blocks out of the face of the breakwater.

The exact action of the sea on structures is waiting the solution of the scientist to determine what forces exist and are exerted by moving masses of water in great storms. The knowledge of the effect of waves of any definite length or height is not determinable with sufficient exactitude by any scientific data that I know of.

I remember while the harbour works were under construction at Dover three concrete blocks piled one on top of the other, each averaging about thirty-five tons, were standing on the unfinished pier. They rested on some timber packings a few inches thick

mark. During a south-westerly storm in the Channel, they were carried across the pier many feet and some into the sea on the lee side. This could only have resulted from at a level of about 8ft. above high-water some reduction of the frictional resistances due to compressed air or hydraulic action on the under side of the blocks and between them and the pier top where a space or void existed. This upward pressure decreased the friction to such an extent that the force of the sea was enough to slide the blocks horizontally. It has been determined in the north-east coast of Scotland that blows due to sea action sometimes amount to from two to three tons per square foot on small areas and up to two tons per square foot on large areas. It would appear that some sort of 'pressure lubrication' was produced between the bearing surfaces which in mechanical design has not, I think, been developed as far as it might be to reduce friction between moving parts.

One has frequently observed, having poured hot water into a glass and turned it upside down on a wet glass shelf, with what small amount of force the glass begins to move along the shelf. This reduction of friction would appear to be due to the air finding its way under the edge of the inverted glass and the movement caused by some small inclination of the glass shelf on which it rests. This, I submit, is an indication of what happened by sea action to the pile of heavy blocks on the unfinished pier at Dover Harbour.

The only information the civil engineer can rely on at the present consists of historic facts which are referred to in different publications on the subject of constructed or destroyed breakwaters. All these point to the advisability of putting the top blocks of any breakwater structure in well-cemented joints, and the leaving of no voids, or joints, near the upper levels of these structures.

This is my excuse for giving a long description of experiences which have come under my own observations.

I have said that the effect of voids among rocks deposited for the purpose of the defence of harbours and ports against the sea, and the cost of the same, are important considerations in connection with sea defence works. The rocks are usually deposited free from all quarry rubbish and earth arising from the 'overbearing' which has been removed; such deposited rocks usually contain within their volume voids to the extent of 42 to 48 per cent. If the whole output of the quarrying operations were deposited without special selection, these voids would be reduced to 30 to 38 per cent.

As can be easily understood, these facts have an influence on the cost of construction. In this connection the amount of selection which is involved, if a 'limiting minimum' size of rock masses is demanded), though not entering into the question of the volume of the voids, materially affects the cost of the deposited rock embankment as a whole.

The voids in any mass of irregular solid lumps are largely influenced (as I have already said) by the uniformity, or otherwise, of the sizes and shapes of the lumps of rock of which a rubble breakwater bank is composed. The cost of a rubble embankment is very much influenced by the necessity arising from specified selections of the limiting sizes of its parts. The rock strata from which the material is quarried also makes a great difference in the ultimate cost if it cannot be blasted into the categories desired. The effect of voids in the mass especially near high-water level, or where the influence of the wind on the sea may result in the inclusion of air in the moving masses of water, is to make for the free escape of this air, and, therefore, for the greater safety of the structure as a whole, though the density and weight of the whole mass containing the larger voids will be less.

This, of course, is in some measure a disadvantage so far as its resistance to the sea is concerned and involves large unit masses of rock. In breakwater design, therefore, as in most things, it is a question of compromise and it is found necessary :—

(*a*) Either to prevent voids entirely where heavy seas are to be encountered near high-water level and to a considerable depth below it, by means of rectangular blocks built closely, or —

(*b*) To make big irregular masses of artificial rock, such as roughly shaped concrete blocks, or—

(*c*) To procure such large rough masses of rock from suitable rock stratifications at not too great a distance or expense.

As to greater depths of a breakwater, however, say at 45 to 50 feet below the low-water level, where there is no included air possible, the matter of voids and sizes of individual portions of the whole mass of the breakwater bank is not so important. I have already given some instances of the effect of included air between rectangular

joints of built masonry and also of the movement by sea action of very massive blocks stacked a little above high-water level at Dover Harbour. I have also roughly described the structure of the great breakwater at Valparaiso in 187 feet of water where, at the lower leves, sand alone forms the basis of the biggest breakwater yet built. This Valparaiso work is an illustration of the varying needs of breakwater construction, subject to very heavy seas, and is daring and original in its design, and great credit is due to the Chilean engineers, Señores Davila and Lira, in their advocacy of this novel construction.

There is another interesting matter to civil engineers in connection with voids, which arises when dredging materials by means of suction pumping. The ease of movement of the material to be pumped and the consequent economy in pumping are largely influenced by the water contained in and surrounding the particles it is desired to move and lift by suction. Mud or clayey material, for example, will allow the water sucked by the powerful pumps to slide over their surfaces, whereas sand and even lumps of rock the size of one's head, if surrounded by water-filled voids, will be moved with relative ease.

(*To be continued.*)

NEW FERTILISER INDUSTRY IN EASTERN CANADA.

The new fertilizers plant of Canadian Industries, Ltd., at Beloeil, is reported to be practically ready for operation. The first shipment of phosphate rock has arrived at the port of Sorel en route for Beloeil, where it will be ground and treated with sulphuric acid in order to form super-phosphate, the principal basis of many fertiliser mixtures.

Prior to the opening of the new plant at Beloeil, the manufacture of super-phosphate in Canada was carried on only by the Triangle Chemical plant of Canadian Industries, Ltd., at New Westminster, B.C. At the present time, however, a very large plant is under construction at the Tadanac Smelter of the Consolidated Mining & Smelting Co. at Trail, B.C.; and Canadian Industries, Ltd., is erecting at Hamilton, Ontario, a super-phosphate plant which is expected to be in operation in a few months time. A dry mixing fertiliser plant is already working at Hamilton.

SEVENTY YEARS AGO.

(From the Chemical News, Jan. 21, 1860.)

TECHNICAL CHEMISTRY.

Notices of some of the Patents taken out for the Preparation and use of the new Purple Dyes generally known as the "Mauve or Perkins' Purple, Harmaline, Violine, Purpurine, Roseine, &c.," with Remarks upon them.

The superb and fast purple colours abtained by the action of bichromate of patash on aniline and its homologues, was discovered by Mr. W. H. Perkins. Dr. Hofmann's researches on aniline were doubtless the true cause of attention being drawn to that base as a substance from which results of practical importance were one day to be obtained; and in the hands of his pupil, the manufacture of aniline purple has become one of the most refined and beautiful manufactures known.

The tendency of aniline to yield colours when subjected to various processes of oxidation has long been known. Solutions of salts of aniline with the mineral acids when evaporated, generally colour the edges of the basins or a red or blue tint. The power of a solution of bleaching powder to develop a charming purple tint even in the weakest aqueous solution of aniline has for many years been known, and applied in the examination of organic bases as a test for the presence of that alkaloid. This reaction has been seized upon as the foundation of a patent granted to Joshua Taylor Beai and Thomas Nesham Kirkham, dated 13th May, 1859. The following quotation from the specification will give a sufficient idea of the nature of the process.

"As examples of some of the more desirable modes of producing the improved dye according to our invention, we give the following proportions and modes of operating: We take one measure of aniline water saturated, and add thereto one measure of acetic acid, say of five strengths, and one measure of hypochlorite of lime, of, say, specific gravity 1010. The hypochlorite should be carefully added, in order to admit of producing the particular shades of violet blues required, as shades of varying depth may be produced by increasing or decreasing the proportion of the hypochlorite. After a while the dye will become lilac, and will dye lilac of various intensities, depending on the quantity of hypochlorite of lime and water that may be mixed with the dye. Instead of adding a solution of chlorine or hypochlorite of lime to the liquor, we sometimes pass

chlorine gas through the latter, carefully watching the same during the process, in order to arrest the further supply of the gas when the desired effect has been produced on the liquid."

With reference to the above we consider that any process found upon the action of hypochlorite of lime upon aniline must be of limited application. In the first place the presence of the bleaching powder would render it impossible for the fabric previously dyed with fugitive colours to be passed through the bath. In the next place it would interfere in many cases with the subsequent application of other colours. But there is a more serious difficulty owing to the sparing solubility of aniline in water, consequently the dye will always be in a very dilute state, and totally useless in practice as compared with the highly concentrated solution sold by Mr. Perkins, at 6l. the gallon. In the next place even the small quantity of aniline which exists in solution will not be totally converted into dye, so that enormous volumes of fluid, involving correspondingly large vessels will have to be employed to obtain a comparatively minute quantity of dye.

Several patents besides that last mentioned have been taken out for producing aniline purple. Among the substances used to oxidise the aniline may be mentioned peroxide of lead, peroxide of manganese, and the green manganate of potash.

MOTOR BOAT SPEED RECORD.

Fresh attempts on the Motor-boat speed records are likely to be made shortly in a fresh venue.

The London Management of the British Empire Exhibition to be held in Buenos Aires next March has received cabled information from Buenos Aires to the effect that the Argentine Yacht Club proposes to hold an International Motor-boat Regatta at Buenos Aires while the Exhibition is in progress.

The regatta, which will probably be held in the last week in March, will, it is expected include attempts to break the world's speed records for motor-boats. The Management of the Exhibition has offered to present a special British Cup.

Any Motor-boat Club, Association or private owner interested in the proposal or wishing for further information should communicate with the London office of the Exhibition, 5, Parliament Mansions, Orchard Street, Victoria Street, S.W.1.

ELECTRODEPOSITION OF NICKEL AT LOW *p*H.

By W. M. Phillips.

(*American Electrochemical Society.*)

A paper emanating from the works of General Motors Corporation deals with the deposition of nickel at low *p*H; advantages and disadvantages of such baths are tabulated as under:

Advantages:—

(1) Increase in plating range. A higher current density can be used without the occurrence of peeling or cracking at the edges of the work. Work of irregular shape can be rapidly and satisfactorily plated, and economy in time and space is effected.

(2) Improved anode corrosion.

(3) Turbidity of the bath is eliminated if the *p*H is kept below about 3.0 except in the case of high-carbon anodes.

(4) The nickel is supplied to the solution from the anodes instead of by the addition of nickel salts, thus effecting economy.

Disadvantages:—

(1) A slightly greater initial tendency to pitting; this is easily adjusted.

(2) Low cathode efficiency. It is believed, however, that the savings due to low *p*H many times offset this loss.

(3) Under certain conditions, excessive anode corrosion may occur; this may be adjusted by the judicious balancing of lead with nickel anodes; the use of the lead anodes simultaneously results in a decreased tendency to pitting.

(4) A tendency towards the gradual increase of *p*H. Minute control is not, however, so necessary in baths of low as of high *p*H, suitable limits for a low *p*H bath being 1—2.5.

(5) Since low *p*H baths must of necessity be operated at high temperatures, materials for tanks and linings of vats are restricted to those capable of withstanding raised temperature.

(6) The range of temperature applicable for "bright nickel-plating" from baths of low *p*H is less extensive than that which can be used with baths of high *p*H.

(7) Low *p*H baths are not suitable for the nickel-plating of zinc-base die castings.

THE EXPANSION OF GASES ON MIXING, ESPECIALLY AT VERY LOW PRESSURES.

I.—Its Relation to the Empirical Calculation of the Fugacities in Gaseous Mixtures.

By Louis J. Gillespie.

From plots of the expansion of a gas in a mixture $(\bar{v}_1 - v)_1$, or of the expansion of gases on mixing to form a mole of mixture from the pure gases at constant temperature and pressure $(\Sigma x_1\bar{v}_1 - \Sigma x_1 v_1)$, as functions of the pressure, it is clear that these quantities do not vanish at zero pressure. These expansions do not vanish for mixtures of ethylene and argon, ethylene and oxygen, nitrogen and hydrogen, and nitrogen and methane, in which cases the limiting values are, according to the existent data, finite and positive. Values for zero pressure can be calculated from a " linear combination of constants " iu the equation of state for the mixture, which values in all cases but the first are evidently suitable end-points for the extrapolation to zero pressure. In the case of argon and ethylene the calculated points are not so suitable, but are reasonably good. In this case the Lorentz formula for the mutual co-volume fits very well and the corrections on the Lewis and Randall rule for argon and ethylene have been calculated to 50 atmospheres from curves drawn according to the Lorentz formula. In a number of cases the corrections differ by 1 per cent. from those calculated by previous investigators, who assumed the expansions to vanish at zero pressure. The empirical calculation of fugacities from the pressure data of gaseous mixtures is in general improved by, if it does not in fact require, some knowledge of the expansions at zero pressure.

LARGE CONTRACT FOR INTERNATIONAL COMBUSTION LIMITED.

The International Combustion Limited of New York, an associated company of International Combustion Limited, London, have recently secured a very large contract. The order covers the following equipment :— 8 boilers each of 530,000 lbs. per hour evaporation at 500 lbs. pressure complete with Murray Fin Tube Furnaces and Fin Tube Economisers for the Brooklyn Edison Company, Hudson Avenue, Brooklyn, New York. They will be fired by Multiple Retort Underfeed Stokers, 26ft, 6ins. wide by 27 ft.

GENERAL NOTES

EXPOSITION OF CHEMICAL INDUSTRIES, NEW YORK, 1931.

Plans for the 13th Exposition of Chemical Industries, which will be held at the Grand Central Palace, New York, during the week of May 4th, 1931, are in progress and rapidly taking shape. During the past summer preparatory work has been done in connection with the Students Course of Lectures and plans are now being laid for it.

The students Course of Lectures will this year again be under the Chairmauship of Prof. W. T. Heau, Dean of Chemistry at Rutgers University, and concerning the Course, he wishes to make the following appeal to the colleges and universities, and others interested.

" Plans are now being made for the Students' Course of the next Exposition of Chemical Industries. Experienee of the 1929 course has indicated that a change of policy is necessary, in order to enable college students to attend such courses toward the close of the college year. The previous fall days found most colleges and universities been opened such a short time that the few days lost from the campus were not a serious matter but with the Exposition coming early in May near the close of the academic year when reviews are under way and final examinations are in sight, it is difficult for any institution to give students of Chemistry and chemical engineering a full week at the Exposition, and the previous system of two parallel courses of six days each, one for elementary and one for advanced students has been changed.

" And instead there will be three successive courses of two days each. One course will cover the elements of chemical engineering equipment, and the more important types of apparatus with which chemical engineering operations are carried out. Following this will be a two days advanced course dealing with the more specialised equipment of recent revelopment in various fields, reviews of research which have marked advances from the theory and principles of chemical engineering. The third course will weal with the new materials and processes of chemical industry, due emphasis being made on the chemical theories and principles rather than equipment, and also with significant topics of chemical economics.

" The regular course for students will be concluded at Noon the last day of the Ex-

tion is extended to High School, College, and University teachers to hear a series of lectures on the teaching value of the Exposition which will be followed by a personally conducted tour to illustrate the material of the lectures.

"While the list of speakers for this series is not complete, those in charge of the institutional part of the Exposition plan to secure a group of lecturers who are recognised authorities in their fields as well as men who can get their ideas across to the students. The previous courses have been very fortunate in getting a very able staff of lecturers and the 1931 course is expected to maintain the high standard of the several courses which have preceded this one.

"Although there are some seven months until the next Exposition opens its doors, plans for the whole academic year are now being made at every college and university. Teachers of chemistry and chemical engineering are urged to arrange now for extra lectures and reviews in advance, in order that their students may be able to attend the particular one of these courses which their training indicates they should need.

"In the past a number of industries have made it possible for members of their operating, sales, and research staffs to attend some of these lectures, and we hope that this policy will be continued."

Already there are about three hundred exhibitors who have reserved space for the forthcoming Exposition, so that even at this early date prospects for an excellent Exposition are very good.

The Advisory Committee of the Exposition includes Dr. Arthur D. Little, Chairman, Raymond F. Bacon, L. H. Baekeland, J. V. N. Door, Lammot du Pont, Henry B. Faber, Moses Gomberg, Williams Haynes, Charles H. Herty, H. E. Howe, Louis Kahlenberg, Sidney Kirkpatrick, Fred W. Payne, W. T. Read, Charles F. Roth, L. V. Redman, H. J. Schnell, R. Gordon Walker, A. H. White, David Wesson, M. C. Whitaker, T. B. Wagner and Victor Williams.

The Exposition is being managed by the International Exposition Company at the Grand Central Palace, New York, with Charles F. Roth and F. W. Payne as Managers.

MERCHANDISE MARKS ACT, 1926.

Marking of Imported Tools.

On the 2nd June, 1930, the Board of Trade made a Direction to the effect that tools and 1929, imported before the 17th December, 1929, which are sold or exposed for sale before the 1 July, 1931, may bear an indication of origin applied to each article by means of a label securely affixed or attached thereto, instead of being required to have the indication or origin applied by die-stamping or other mode of impressing, etching, engraving or casting.

The question whether the Merchandise Marks (Imported Goods) No. 5 Order 1929, should be amended, either in accordance with the terms of the above direction or otherwise having been referred to the Standing Committee appointed by the Board of Trade and representations having been received on the subject from certain interests concerned the Committee will hold an Enquiry into the matter at 11.30 a.m. on Monday, the 17th of November next.

The Enquiry will be held at the Board of Trade offices, Great George Street, London, S.W.1. Any communications on the subject should be addressed to the Secretary, Mr. F. W. Reardon, at that address.

MODERN CHEMISTRY.

The Harveian Oration.

The Harveian Oration was delivered at the Royal College of Physicians, Pall Mall East, on October 18, by Professor J. B. Leathes. The President (Sir J. R. Bradford) was in the chair.

Professor Leathes said that the 10 years after the death of Harvey formed a remarkable epoch in the history of physiology. Biological chemistry came to birth in some papers published by John Mayow, who died at the age of 39 and was forgotten for a hundred years after his death. If it had not been for the experiments and writings of Mayow, the discovery of oxygen would not have been made good, nor the doctrine made clear that all the activities of animals invoved the oxidation of organic substances conveyed by the blood. Mayow's discoveries rediscovered were the starting point of modern chemistry. It was fitting that he should be remembered in the twentieth century, if only because he was so sadly forgotten in the eighteenth century.

Two medals which are awarded every third year were presented after the Oration. The Moxon medal for clinical medicine was presented to Dr. F. P. Weber; and the Weber-Parkes medal for tuberculosis research to Professor S. L. Cummins.

Among those present were Sir E. F. Buzzard, Sir A. E. Garrod, Sir G. H.

Proceedings and Notices of Societies

THE CHEMICAL SOCIETY.

Papers read on Thursday, October 23 :—

Dynamic Isomerism Involving Mobile Hydrocarbon Radicals. Part II. The Intramolecular Character of the Amidine Rearrangement. By A. W. CHAPMAN.

The interconversion of the isomeric triarylbenzenylamidines follows a unimolecular

$$\mathrm{PhC}<\begin{matrix}\mathrm{NAr}\\ \mathrm{NAr\,Ar'}\end{matrix} \overset{\text{heat}}{\rightleftharpoons} \mathrm{PhC}<\begin{matrix}\mathrm{NAr_2}\\ \mathrm{NAr'}\end{matrix}$$

course and is not accompanied by the formation of any considerable amounts of by-products. There is no indication of a catalyst being necessary for the rearrangement and no exchange of groups between different molecules is involved.

The rearrangement is therefore regarded as intramolecular in character.

Part III. Some Effects of Substitution on the Velocity of Interchange and Position of Equilibrium of Isomeric Triarylbenzenylamidines.

The interconversion of four pairs of isomeric triarylbenzenylamidines has been studied.

$$\mathrm{PhC}<\begin{matrix}\mathrm{NAr}\\ \mathrm{NAr\,Ar'}\end{matrix} \overset{\text{heat}}{\rightleftharpoons} \mathrm{PhC}<\begin{matrix}\mathrm{NAr_2}\\ \mathrm{NAr'}\end{matrix}$$

The order of increasing mobility of the following three aryl groups, other things being equal, is *p*-tolyl<phenyl<*p*-chlorophenyl.

For the same migrating group (Ph) substitution of a *p*-chlorophenyl group for a *p*-tolyl group in the amidine system retards the isomeric change.

The results are to be expected from analogy between the imino-aryl ether and amidine rearrangements and it is concluded that the two changes are identical in mechanism.

The Unsaponifiable Matter from the Oils of Elasmobranch Fish. Part VII. The Synthesis of α-Glyceryl Ethers and the Constitution of Batyl, Selachyl and Chimyl Alcohols. By G. G. DAVIES, I. M. HEILBRON, AND W. M. OWENS.

It was previously shown (A., 1928, 616) that batyl alcohol (m.p. 70.4-71°) is either $C_{18}H_{37}\cdot O\cdot CH_2\cdot CHOH\cdot CH_2OH$ (I) or $C_{18}H_{37}\cdot O\cdot CH(CH_2OH)_2$ (II). The synthesis of (I) has now been carried out by first condensing octadecyl chloride with sodium allyloxide when *octadecyl allyl ether*, m.p. 27.5-28.5°, is produced. Oxidation of this with perhydrol gives *α-octadecyl glyceryl ether*, m.p. 70-71° (*phenylurethane*, m.p. 95-96°). This substance is not identical with batyl alcohol as on mixed melting definite depressions are observed, both with the alcohols and with their respective phenylurethanes. Batyl alcohol must have the structure (II).

The Unsaponifiable Matter from the Oils of Elasmobranch Fish. Part VIII. The Structure of the Naphthalene Hydrocarbon Derived from Squalene. By I. M. HEILBRON AND D. G. WILKINSON.

Oxidation of the naphthalene hydrocarbon $C_{13}H_{14}$, obtained by dehydrogenation of tetra*cyclo*squalene (A., 1927, 130) with potassium ferricyanide, yields a naphthalenetricarboxylic acid (*methyl* ester, m.p. 89°) showing that the hydrocarbon is a trimethylnaphthalene. Oxidation with chromic acid gives (*a*) *2-aceto-6-methylbenzoic acid*, m.p. 126° (*methyl* ester, m.p. 47-48°; *semicarbazone*, m.p. 177°), (*b*) *2-aceto-5-methylbenzoic acid*, m.p. 125-126° (*methyl ester*, m.p. 71-72°; *semicarbazone*, m.p. 182°) and (*c*) *2-aceto-5 : 6-dimethylbenzoic acid*, m.p. 105° (*methyl* ester, m.p. 78-79°; *semicarbazone*, m.p. 217°).

In addition to these acids a neutral portion was obtained from which 1 : *6-dimethyl-α-naphthaquinone*, m.p. 94°, was isolated together with a substance of empirical formula $C_{16}H_{16}O_4$, m.p. 70-71°, probably 1 : 6*dimethyl-5 : 8-diacetoxynaphthalene.*

When the chromic acid oxidation was arrested before completion a 1 : 2 : *5-trimethyl-β-naphthaquinone*, decomposing above 130°, was also isolated. These results prove that the hydrocarbon is either 1 :3 :8- or 1 : 2 : *5-trimethylnaphthalene*. As, however, it is different from the synthetic 1 : 3 : 8-trimethylnaphthalene it must be the 1 : 2 : 5 isomeride, a conclusion definitely confirmed by the synthesis of the latter by Ruzicka.

THE CHEMICAL SOCIETY OF JAPAN.

Papers communicated :—

Catalytic Chlorination. II. Reaction Between Naphthalene and Chlorine in the Presence of Reduced Copper. By SHIGERU KOMATSU AND SHOZO TANAKA.

Catalytic Action under High Pressure and Temperature. II. Catalytic Action of Reduced Copper on Phenols. By SHIGERU KOMATSU AND MOTOE HAGIWARA.

Ketones. By SHINTARO ARAKI.

Terpenes and Related Compounds. V. Ethoxyisoeugenol and Ethoxyisochavibetol. I. By NENOKICHI HIRAO.

Catalytic Action under High Pressure and Temperature. III. Catalytic Reduction of Benzene and Naphthalene by Reduced Copper. By SHIGERU KOMATSU AND KIICHIRO SUGINO.

Measurements of Heat of Vaporisation under Reduced Pressure. By GAKUJI TAKAHASHI AND HAYASHI NUKADA.

Influence of Antioxidants on Oxidation of Unsaturated Fatty Oils. IV. Antioxidative Action of Hydroquinone and Diphenyl Guanidine. By BUNNOSUKE YAMAGUCHI.

BRITISH SCIENCE GUILD.

Science Discipline. By LIEUT.-COL. SIR DAVID PRAIN, L.M.S., C.M.G., C.I.E., M.A., M.B., LL.D., F.R.S.

Lt.-Col. Sir David Prain, C.M.G., C.I.E., F.R.S., delivered the second annual Alexander Pedler Lecture (founded by the British Science Guild in memory of Sir Alexander Pedler, F.R.S.) on Wednesday, October 22, in the University of Liverpool, under the joint auspices of the Guild and the University. The subject of the Lecture was "Science Discipline."

Huxley, he said, held that in an ideal University a man should be able to obtain instruction in all forms of knowledge, and discipline in the use of all methods by which knowledge might be obtained. For him there were three forms of knowledge: the limits of one's individual powers, the uses to which these powers may be put and the conditions under which these powers can be used. These forms of knowledge were the same for literature as for science, for science and literature were but two sides of the same shield. Science, however, no longer connoted all knowledge, but meant more particularly "natural knowledge." Science discipline, therefore, implied cultural exercise of every method by which natural knowledge could be obtained, as contrasted with science training, which implied technical exercise in any method by which natural knowledge might be employed.

The sole object of Science Training was to make an adequate number of scholars, already disciplined in the requisite natural knowledge, competent to give the general community effective scientific help, and confusion should be impossible between training and discipline in this sense. The purpose of discipline was twofold: On the one hand to furnish those who wished to serve the community scientifically with the kind of natural knowledge that would enable them to profit by training for technical efficiency; and on the other hand, to render all scholars in any ideal University competent to appreciate the scientific help afforded the community by those specially trained to give it. This second object was not less important than the first. And, while the first of these ends had now been largely attained, perhaps in due course the need for securing the second might come to be appreciated by those responsible for the organisation of science discipline.

The XIV Century Faculties of Theology, Law and Medicine were technical faculties where everything about God, or Man, or Nature was taught to Clerks who already knew something about everything. But it was found difficult to man the Faculty of Medicine, and the Cultural Faculty of Arts was often deprived of a valuable "ingredient in Education" by assigning to the technical faculty all suitably equipped teachers. The Church approved, eager to secure control of ethics and philosophy. In the next two centuries, Universities "complete with all the faculties" came into existence under ecclesiastical patronage and a new spirit of criticism spread from the cultural to the technical faculties. It disputation led to confusion, there was compensation in the improvement in Science Discipline. Controlled experiment was substituted for empirical test. But, teachers who were prepared to abandon scholastic controversy could not resume instruction in a technical faculty for lack of the experimental discipline in themselves. There was cleavage. While Catholic Faith tolerated the "relief of man's estate," Reformed Faith could see in precautions against plague proof of "distrust in Providence." Men of science formed an "invisible College" outside the Universities, where they could talk in safety. The sciences became the arts and the arts the sciences. In the 18th Century when the English "common people" were "constant irreconcilable enemies of science," natural philosophers were thus led to leave application to the initiative of the Arts and Crafts, and the old distinction between an art and a science appeared in a new form, contrasting what "they were inclined to" with "what they had a mind to."

Association with a technical faculty enabled teachers of Natural History to avoid this error for nearly a generation, and soon, as Huxley said, scholars who wished to obtain a training in physical science had to attend the instruction of the Medical Schools. Universities came to regard the teachers of the Medical Faculties as responsible for science discipline as well as training. Botany, by its return to the study of function had made itself the first academic science to realise that "what people call applied science is nothing but the application of pure science to particular problems."

It needed the lesson of the Great War to convince our legislators of the truth of this remark, and an Association for the Advancement of Science had to reach its hundredth year before it found a President courageous enough to say that between pure and applied science there was no real distinction.

There was room for hope that academic opinion might now cease to consider second-rate advancement more important than first-rate application of natural knowledge. General cultural science discipline was the proper business of faculties of Arts, not of Science. A special scientific discipline, preparatory to technical training also had its place within the Universities, and demanded recognition and special organisation. Sound practical instructiou in the elementary facts and broad principles of biology should form part of the Arts curriculum. The discipline in physiology that a prospective scholar of medicine must undergo might in itself provide a better education than much that was accepted under that name. With anatomy, it had its place in the science faculty. Huxley had been aware that with the necessity for direct practical perception of facts there arose the need for an amount of personal labour and a development of means and appliances, and he knew that these needs created difficulties that would not be removed until years of patient study had organised scientific teaching as well as, or better than, classical teaching. The absence of any serious attempt on the part of those entrusted with University organisation to devote themselves to the "patient study of scientific teaching" in their faculties of arts was directly responsible for much of the justifiable disquietude felt by both teachers and scholars of the natural knowledge to-day.

The failure to follow Huxley's advice had been due not to disbelief in his judgment but to the national propensity, which made neighbouring nations dislike us, for doing one thing when we imagined we were doing something else. It was of less consequence for teachers of science to fail to distinguish between the functions of a technical and a cultural faculty than to fail to make their Universities understand the difference in method between the Science Discipline for culture and the Science Discipline that prepared for training. Teachers of literature, with a like problem before them, experienced no such difficulty in persuading their Universities to do what they required. But they need not despair.

INSTITUTE OF CHEMISTRY.

The results of the September examinations of the Institute of Chemistry of Great Britain and Ireland have been issued, as follows :—

Examination in General Chemistry for the Associateship :

Erasmus Thomas Buggé, B.Sc. (Lond.), Birkbeck College London; Alfred Walter Doyle, A.M.C.T., College of Technology, Manchester; Albert Henry Fuller, Technical College Leeds; George Richard Gilson, Municipal Technical College, Hull; Thomas Hayes, Technical College, Leeds; David Arnold Hudson, Technical College, West Ham; George Harold Jeffrey, B.Sc. (Lond.), University College, Southampton; John Walker Spence, Chelsea Polytechnic, London.

Examination for the Fellowship (Branch E : The Chemistry, including Microscopy of Food and Drugs, and of Water) :—

Cecil Abell Bassett, B.Sc. (Birm.); Donald Frank Harrington Button, A.R.C.S.; James Frederick Clark, M.Sc. (Lond.), A.R.C.S.; Ernest Stephen Hawkins, B.Sc. (Lond.), A.R.C.S.; Albert Houlbrooke, M.Sc. (Liv.); Reginald Arthur McNicol, M.Sc. (Lond.); Charles Percy Money, B.Sc. (Lond.); Francis Edwin Needs; John Edwin Ritchie, M.A., B.Sc. (Aberd.); Ronald Henry Maxwell Savage; William Arthur Waygood, B.Sc. (Lond.), A.R.C.S.

Branch G : Industrial Chemistry :—

Lionel Hewgill Smith.

NOTICES OF BOOKS.

Neuere Torfchemie. By PROF. G. STADNIKOFF. Pp. viii + 166. Dresden and Leipzig: Theodor Steinkopff. 1930. Price 12 marks.

Prof. G. Stadnikoff, who is the scientific principal of the State Coal Research Institute at Moscow, has written a valuable and timely *Monograph* on recent investigations into the chemistry of peat.

By the applications of modern physico-chemical knowledge and methods he (and others) have been able to approach the study of the chemical nature of peat from a different angle and it has been possible to make progress in directions which were inaccessible to simple analytical methods.

The *Monograph* includes an account of the general characteristics of peat and peat bogs, the nature of the associated water (85-91 per cent. of the crude peat) and its removal by (*a*) drying, (*b*) electro-osmosis, and (*c*) by coagulation processes with colloidal iron hydroxide or calcium sulphate. The large-scale " Madruck " process and its recent modifications are also described.

Data concerning the composition of Russian peats and the significance of the variable ash contents, etc., are discussed and the methods and products of distillation are described. Peat bitumen, humic acids and peat tar are also described in separate chapters so that Prof. Stadnikoff's volume will prove of value to fuel technologists as well as to those studying colloidal phenomena and their application. Organic chemists in general will also be interested in the author's results.

Forthcoming Events.

ROYAL INSTITUTION.

21, Albermarle Street, W.1.

Tuesdays Nov. 4 and 11 at 5.15 p.m.—"New Aspects of Radioactivity." By C. D. Ellis, Ph.D., F.R.S.

Thursdays. Nov. 6 and 13 at 5.15 p.m.—" The Physiology of Water." By J. B. S. Haldane, M.A.

OIL AND COLOUR CHEMISTS ASSOCIATION.

Friday, Nov. 7th at Milton Hall, Deansgate, Manchester, at 7.0 p.m.—Joint Meeting of Manchester Scientific Societies.

SOCIETY OF PUBLIC ANALYSTS.

The next Meeting of the Society will be held on Wednesday, November 5th, at the Chemical Society's Rooms, Burlingtou House, Piccadilly, W.1., at 8 p.m. The following papers will be read :—

"The Analysis and Composition of Vegetable Parchment used for Packing Diary Products." By Paul Arup, M.Sc., F.I.C.

" The Determination of the Milk Proteins." By George M. Moir, M.Sc., Ph.D., A.I.C., Pedlar Research Scholar of the Institute of Chemistry. A Summary of this Research will be given by Captain J. Golding, D.S.O., F.I.C.

" The Lead Reduction Method for the Volumetric Determination of Tin, and the Interference of Copper and Antimony." By S. G. Clarke, B.Ss., Ph.D., A.I.C.

" A New Method for Determining Traces of Chromium in Steel." By W. P. Agnew, B.A.

ROYAL INSTITUTE OF PUBLIC HEALTH.

Wednesday, Nov. 5th at the Lecture Hall of the Institute, 37, Russell Square, W.C.1. at 4 p.m.—" The Prevention of Tuberculosis." By Prof. S. L. Cummins, C.B., C.M.G., M.D.

THE INSTITUTE OF METALS.

North East Local Section.

Tuesday, Nov. 4th at the Electrical Engineering Lecture Theatre, Armstrong, Newcastle-on-Tyne, at 7.30 p.m. " Gases in Metals." By S. L. Archbutt.

MINERALOGICAL SOCIETY.

Tuesday, November 4, at 5.30.—Anniversary Meeting.—Mr. Arthur Russell : "An Account of British Mineral Collectors in the 17th, 18th, and 19th centuries."—Mr. M. H. Hey : " Cupriferous Melanterite from the Skouriotissa Mine, Cyprus."—Dr. C. E. Tilley : " The Dolerite Chalk Contact-Zone of Scawt Hill, Co. Antrim; the production of basic Alkali-Rocks by the assimilation of Limestane by Basaltic Magma : with Chemical Analyses by Dr. H. F. Harwood.—"Dr. Frank Smithson : " A Sample Method of Observing the Magnetic Properties of Mineral Grains."

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

29,956.—(I. G. Farbenindustrie Akt.-Ges.). —Recovery of fatty acids from oxidation products of hydrocarbons. Oct. 7.

30,007.—(I. G. Farbenindustrie Akt.-Ges.). —Manufacture of nitro arylamino derivatives of leuco sulphuric acid esters of anthraquinonoid &c. Oct. 7.

Specifications Published.

30,149.—(I. G. Farbenindustrie Akt.-Ges.). —Manufacture of absorbent silicic acid. Oct. 8.

335,898.—(I. G. Farbenindustrie Akt.-Ges.). Manufacture of fast azo dyestuffs.

319,20..—Rheinische Kampfer Fabrik Ges. —Catalytic alkylation of hydrocarbons, alcohols, organic acids, and amines.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

FRADOR.

513,698.—All goods in class 2 which includes chemical substances used for agricultural, horticultural, sanitary and veterinary purposes.—John Bell, Hills & Lucas, Ltd., Oxford Works, 14, Tower Bridge Road, London, S.E.1. Oct. 15th. (Associated).

GRAMMAR OF LOGIC.

100 Questions and Answers on The Grammar of Logic or How to Reason Correctly. By J. E. Roscoe, M.A., Oxon.

An invaluable Book for all who desire to excel as speakers and who wish to reason convincingly.

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Merton House, Salisbury Square,
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GENERAL INDEX TO THE
"CHEMICAL NEWS"—VOLS. 1 to 100.

This large Volume contains a detailed Index to the first 100 Volumes of the *Chemical News*, and will be found of great value to all interested in Chemical Engineering, Electrical and General Scientific subjects. It has been compiled with great care, is handsomely bound in red cloth, and has been produced at great expenditure of time, labour and money. Carriage paid, Great Britain, 21/- net; Carriage paid to Foreign Countries and the Colonies, 23/- net.

BRICK KILN PATENT FOR DISPOSAL.

Mr. V. Lastovicka, of the Japan and China Trading Co., 56, Rasin Embankment, Prague, Czechoslovakia, is open to receive offers for the exploitation of his patented "Tunnel" Brick Kiln Construction in Great Britain and Dominions and Colonies.

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BRITISH PATENT.

It is desired to secure the full commercial development in the United Kingdom of British Patent No. 275,044, which relates to "METHOD OF PRODUCING CAUSTIC ALKALIES," either by way of Sale or the grant of Licences on reasonable terms.

For particulars apply PHILLIPS'S, 70, Chancery Lane, London, W.C.2.

AN IMPROVED BODE'S LAW AND THE TRANS-NEPTUNIAN PLANETS AND THE ORIGIN OF THE SATELLITES.

By F. H. LORING.

In this Journal of October 17th and 24th (pages 245 and 257 of this volume), Bode's law or rule was given in an improved form, the equation being :— $n'm/n''+4=D$, where n' is an arithmetical progression series characterised thus: 0, 1, 2, 3, 4, 5, 6, 7, 6, 5, 4, 3, 2, 1; m is a geometrical progression series beginning at $1\frac{1}{3}$ and doubling at each step; n'' is another arithmetical progression series characterised thus: 0.0_n1, 1.0_n2, 2.0_n3 to $n''=13.0_n14$, with the same step-difference, 1.0_n1, throughout (fully explained in the first citation above), n being several noughts in order to bring the starting term to zero by assigning a small positive value to the second nought in the equation "$0/0=0$."

D is, of course, the distance of the planet from the sun multiplied by 10, which is plotted as Fig. 1 below. The measured values are shown by small circles with the planet's name attached thereto.

It will be seen that this plotting seems to be best represented by *two* curves crossing each other at Uranus.

An interesting feature now presents itself. Do the planets owe their positions to two cooperating causes suchwise that at the region of Pluto there may be another planet while in those places nearer to the sun (as indicated by the broken-curve) any extra planets have long since been broken up on account of their nearness to the large planets, and the fragments, so to speak, form the satellites of all large planets, and the small stuff forming the asteroids and Saturn's rings? Jeffreys has suggested that the satellites of Mars are captured asteroids. Why not carry the idea further as here shown?

There is a scrap of evidence pointing at least to one other trans-Neptunian planet besides Pluto; as, according to *Nature* (1930, *125*, 721), the following is given under the title: "The Lowell Planet." Among other statements several orbits according to E. C. Bower and F. L. Whipple in the *Lick Bulletin*, 421, are given: Four ellipses are cited with periods 229, 390, 264, and 264 years. Also two parabolic orbits were considered. It appears that Prof. W. H. Pickering in a letter states that he has found a period of 210 years. *Harvard Announcement Card*, 123, states that Mr.

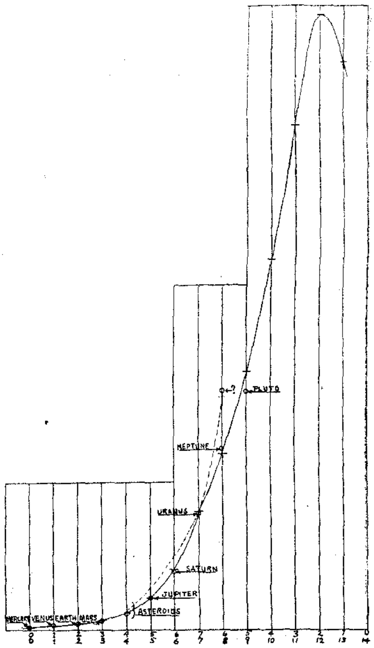

Fig. I.

This is a reduction, from the original drawing, about 4 : 1 linearly. Distance between ordinates 20 millimetres, D/2 plotted thereon in millimetres.

Henroteau and Miss Burland have discovered an object on plates taken at Ottawa in 1924 that appears to be trans-Neptunian, but cannot be the Lowell object, being too far north. The positions are given in *Nature*, from which Dr. Crommelin derives the following circular elements referred to equinox of 1924 :—Distance, 39.82; period, 251.3 years; node, 280° 29.4′; inclination, 49° 7′. *It is stated that in the case of the* Lowell planet the circular hypothesis gave a good approximation to the distance so "it may do so here also."

The nearness of Pluto to the planet indicated by the query (39.8 astronomical units distant from the sun) might suggest the existence of a *third planet* so that they, like the Trojan group of the asteroids, may represent another example of the Lagrangian solution of the problem of *three* bodies whereby stability is obtained, but this is obviously only a guess.

Theories are *not* like Tennyson's brook, but even so, they do suggest experiments, and sometimes the experiments yield results that prove the rule.

The above views, as based partly on the two curves shown, raise several questions which are difficult to answer. In the first place, the formula can only be regarded as an approximation and therefore the curves, *especially where they overlap* (the broken-line parts), cannot be exact. In the second place, it is difficult to imagine a capture theory as indicated without a full mathematical treatment.

Furthermore, assuming that there are several trans-Neptunian planets, it will be seen that Pluto deviates sufficiently from the calculated position, as shown on Fig. I, to suggest greater deviations for the other remote planets in question beyond Neptune; but there is one consoling feature, the agreements are not too good in the outer region, which might be expected as such deviations, *relatively speaking, represent little energy*, this energy of course involving a long period of time, while the sun's attraction there is weak. The forces are such that the remote planets would suffer considerable perturbation, and it would not be expected that they should conform to any regular series without applying some form of correction.

The reader may find the following pages of the *Chemical News* of some interest in this connection, as they contain notices of some of the earlier work and studies on the problem of the trans-Neptunian planets :—Vol. *140*, pages 279, 299, 313, 325. The *latest* work is referred to in the first citation above. See also "Planet X" by H. N. Russell, *Sci. Amer.*, July, 1930, 20; also by the same authority a similar article, Nov., 1930, 364. In the Editor's note the two following sets of values for Pluto are given: Bower and Whipple : Perihelion passage due Feb. 27.473, 1989; eccentricity of orbit 0.253741; inclination 17° 8′ 57″; period 249.1661 years. Nicholson and Mayall give June 5.5, 1968; 0.2575; 17°; 251.80 years.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

Section G.—Engineering.

THE INTERDEPENDENCE OF SCIENCE AND ENGINEERING WITH SOME EXAMPLES.

By Sir Ernest Moir, Bart., M.Inst.C.E., M.Am.Soc.C.E., *President of the Section.*

Bacteriological and Entomological Sciences and their Influence on Civil Engineering.

Concluded from page 280.

Some very large and important works could not have been carried out without great loss of life but for the discoveries of Sir Ronald Ross, Sir Patrick Manson, Bruce and others in connection with the disease-carrying powers of certain mosquitoes, and especially the stegomyia and anopheles mosquitoes which transmit yellow fever and malaria.

In the early days of De Lesseps' efforts to build the Panama Canal the death rate was very high indeed, and did more to make the first efforts a failure than anything else, unless perhaps finance or economics. I do not think Sir Ronald Ross has been recognised by our civil and other engineering institutions as much as he should for his wonderful work in this connection. When the American Government undertook the construction of the Panama Canal the success of this great scheme probably owed more to the science of bacteriology than to civil engineering. The only other great difficulty which might have prevented its ultimate completion was the question of cost and the sliding in of its sides at the Culebra Cut, which resulted from the local geological formation. It is a credit to those who designed and carried it out, but the science of medicine played as great a part, if not greater, than any other science in its accomplishment. In my own experience in the construction of the Port of Para in Northern Brazil, I have been much helped by this branch of science. While we did not entirely eliminate yellow fever from our staff, we did reduce it to a small number of cases and had very few deaths. We had also to fight yellow fever in Mexico and Colombia in connection with civil engineering works and not without loss among our staffs. My firm and the governments for which we worked owe their thanks to the help of medical science in the widest sense. There are still some fields to conquer in this connection, where we need the bacteriologist and medical scientist to aid us. I refer, *e.g.*, to Varugus disease which caused such destruction of life in the building of the Central Railway of Peru many years ago through the Varugus Valley which was named after the disease which existed, and still exists, to the injury of man and the advancement of civil engineering enterprise. I was in this valley in 1925, visiting the results of a terrible engineering disaster due to unprecedented rains. Rain had not fallen in that part of the Andes for thirty-five years, and when it did so it washed down the mountain side and buried the railway for miles, sweeping away bridges and diverting the river, and causing very great damage. The Varugus disease was still there and its causation unknown. Great care was taken to move away all the staff at night. This precaution was based on the experience of the engineers in charge of the work, and special measures were taken by the management under General Cooper which were productive of good results, but I was informed by those on the spot that they were still having trouble from the disease among their men.

The latest enemy for which the engineer wants the aid of the parasitologist and scientific medicine is the disease called 'Bilharziasis' which is causing great trouble in Egypt and preventing the free movement of that splendid worker, the fellah, to the upper reaches of the White and Blue Niles to assist in the construction of the great dam and canal systems which are now engaging the irrigation engineers. The life-history of its mobile germ is being followed out, and we must all hope, from a humanitarian as well as an engineering point of view, for an early and successful attack on this, I think, the latest enemy of the civil engineer and the progress of his work. Black water fever on the west coast of South Africa, sleeping sickness and the tsetse fly are three more cases where the help of the sciences of medicine and bacteriology are invited to assist the pioneer engineer in parts of the world requiring transport facilities.

The civil engineer has been the means of helping himself and his fellows in one special case, that of working in high pressure air, which has involved serious injury in the past to the men employed in very important work. In this case, while death and injury occurred in a very high percentage only a few years ago, the dangers have now been

much reduced, thanks to the civil engineer. Air under pressure is required in the sinking of bridge foundation cylinders and in the driving of subaqueous tunnels, and the resulting illness is commonly called caisson disease, diver's palsy or 'bends,' the latter name being due to the bodily distortions of the sufferers. This in its essence is a mechanical disease, and for this reason the medical profession did not advance far in ascertaining its cause. It was the civil engineer who through bitter experience and long-continued observation, found a cure. Chance gave me, forty-eight years ago, while at the Forth Bridge, the opportunity to study this disease during the sinking of the caissons which were being built and sunk under air pressure. At a later date the appalling death rate under the much higher pressures and much worse conditions that attended the construction of the Hudson Tunnel, New York, necessitated something being done to ameliorate the life of those who worked for me, and to make it possible to get the men to face the dangers of carrying on the construction of this, the first subaqueous tunnel built in the United States. The work had been commenced many years before, and much pain and many deaths had occurred, but without any cure having been discovered. Many months of continuous observation on these undertakings enabled me to ascertain certain facts and to devise a scheme of treatment—the use of recompression in a medical airlock—which is now always adopted on undertakings where compressed air is being employed, and with great success. These experiences also led me to discover contributory causes not realised up to that time, namely, among others, the necessity for much purer air than is required in workings at atmospheric pressure, and further the benefits arising from stage decompression. I had mules continuously under air pressure for many months, and they did not suffer at all from this long immersion but, like human beings, they suffered badly on passing through the air locks when coming out and getting back to normal atmospheric pressure. By simple re-immersion in high air pressure and by very slow decompression treatment, which is a very gradual withdrawal of the pressure while still keeping the air pure, I was able to reduce the death rate among the men at the Hudson Tunnel in 1890-2 from 25 per cent. per annum to 1¼ In the Blackwall Tunnel in 1893 there were no deaths at all during the whole course of the works. Since those days Prof. Haldane, Prof. Sir Leonard Hill and Captain Damant, to mention the chief workers in this field, have carried the work of regulated decompression further and brought the rough discoveries I made and introduced to a more exact scientific basis; and much greater depths of immersion involving higher air pressures are now possible and safe by means of stage decompression. Here is a case where the civil engineer has helped the science of medicine—a return for some of the benefits received from the bacteriologist and medical man.

During my investigations I tried to ascertain the actual blood pressures in the human body but so far these have never been taken. Only comparative, not actual, pressures can be taken, but I feel sure there is a great deal to learn from a more complete knowledge of the effect of varying blood pressure, especially in its influence on the brain and spinal column. Also from the purely hydraulic and mechanical point of view including the possible distention and contraction of the veins and arteries due to the reaction on the muscles of their structures, where fluid pressures may vary within them and between wide limits. Engineers and medical men should work together on some of these things, with both bacterologist and entomologist. Already the entomologist and chemist combine for the destruction of wood-destroying insects—the death-watch beetle, the pine 'bug,' the white ant and the toredo, fresh-water shrimp, dry rot—for the preservation of timber. The treatment of sewage is another matter where the bacteriologist has helped the civil engineer.

As influencing the health of workers, another question is the possible electrolitic action in the decay of teeth by the mixture of metals in the stoppings. This appears to me wanting investigation. The currents set up are no doubt very small, but they may go on for years. Here the pure physicist might come in, if not the electrical engineer.

Economics of Engineering Construction.

The economics of engineering construction naturally divided themselves into several categories. The first of these arises out of the purpose of the engineering works or enterprises. If we take Great Britain as our example, we have public health requirements, including water supply, sewerage, lighting, national road-making, and transport services. These are works in which the financial requirements are based and provided for on the credit of the community using them, issued and financed by the Gov-

ernment or Municipality through the investing public, arranged generally by some financial house and, from that house, allotted to the investor by means of a public issue, or they may be provided out of revenue by an Act of Parliament. These are among the easiest financial operations, especially when the borrowing is done by the Central Government, which commands the highest form of credit.

Another category involves enterprises that are to be financed on the basis of possible earnings and includes the public utilities not yet socialised, such as railways, docks, privately owned harbours, gas and electrical undertakings, and the bulk of the transport facilities, with the exception of roads and bridges. Since the abolition of the tolls, the latter have been undertaken, like works in the sanitary and health categories by the governmental, county, or other trusts or public bodies.

Finance for profit-earning enterprises is arranged through loans by issuing houses which as a rule are fully underwritten. Public issues are made and they have until quite recently been an easy matter. The experience of the common stock holder in this connection has not been always encouraging, and it often happens that his holdings are overborne by preference stocks and debenture issues, with the result that many investments, which in my youth were looked upon as beyond suspicion, have fallen heavily in capital value as well as in earning power. This state of things has naturally reacted on the extent of engineering enterprise and has in some measure reduced the training-ground for engineers and contractors at home, and therefore lessened the chance of Britain securing foreign or Dominion work in competition with the world. Naturally, a densely populated country, which for years has been providing itself with all sorts of facilities for transport, health and comfort, must sooner or later have been fully provided with the facilities envisaged in the categories above indicated. There seems little doubt that railway building and the great mass of engineering work that it involves has nearly reached saturation point in these islands although there is still much to be done abroad.

The next category that interests the constructive engineer, and makes for his employment, from the financial point of view is the needs of manufacturing and industrial undertakings. These comprise too many categories to attempt to classify them all. It takes, however, a greater faith and more enterprising spirit to raise money for this kind of work that it does for anything I have mentioned before, and, as a consequence, the financing of factories and ancillary works, immense chemical industries, shipbuildng yards, collieries, coal handling and loading devices, private harbours and gas works, with the greater financial risks that they involve and the greater probability of obsolescence as well as more rapid depreciation, requires higher rates of interest and provision of larger sinking funds to procure the necessary money.

One could enlarge on these lines, but I would prefer to deal with the questions of finance and economics connected with large civil engineerng enterprises abroad and mostly undertaken for foreign governments. These are generally guaranteed financially by such governments and/or secured on monopolies under their control, and the effect upon those who act as financiers and contractors in connection with them needs careful consideration.

After the security has been provided and the finance arranged for, the contractor may possibly have to take his payments in scrip. Estimates for foreign work involve questions of exchange, values of local untrained labour and its efficiency in countries abroad, and other matters entailing considerable risk and requiring a knowledge of the science of economics.

The financing of the works of construction by the contractor may involve deposited guarantees, and will also require money for purchase and transport of plant and machinery, the engagement of staff with a knowledge of foreign languages, agreements as to supplies of material and provision of housing.

Many foreign governments demand large deposits in advance as guarantees of good faith, and undertakings by banking institutions as to the financial capacity and technical ability of those who offer for the work of construction.

Our British joint stock banking system does not lend itself to the provision of such requirements and guarantees, although there is some welcome evidence that this may be altered shortly, as intimated recently in the press.

Foreign contractors, on the other hand, do not have these difficulties to face to the same extent. The German, French and American banking houses especially have entered into this sort of business for years, and no doubt

they share in the profits which arise, and also take some of the risks of losses with the contracting firm.

The responsibilities thrown upon a contractor who has made the arrangements indicated above vary considerably according to the accuracy or otherwise of his estimate based on the information given to him or otherwise obtained, and the amount of cover he provides for risks that are not taken by the employing government or company or scheduled by those who advised them. As examples, there are political risks arising from revolutions or wars threatened or actual climatic risks including risks of sea action and possible destruction of the work, in some cases even the risk of design—risk arising out of exchange and depreciation of currencies in the country in which the contractor is working—risks of labour disturbances and variations of wage rates either in the country in which he works or arising out of, *e.g.*, a coal strike in England if he is dependent for supplies of fuel from this country; risk arising from the capital required and the interest on such capital; risks of diseases among the staff, either from the nature of the work or the climatic conditions, which may be so bad that the labour required is very difficult, or perhaps nonexistent. The available means of access of transport are also important as well as the provision of food and other supplies. Apart from these in some cases the contractor takes earthquake risks, those of inundation from rivers in irrigation works, the risks of the strata of the foundations on which heavy structures have to be placed, risks of the borings and data handed to him on which to make up his tender being accurate or not. Further, if it is a sea work upon which he is engaged and an immense rubble dam for the base of a breakwater is required, there is the risk settlement into the sea bed which is nearly always thrown upon the contractor, and sometimes that has involved him in very great loss. Penalties for non-completion in time fall upon the contractor, but generally with fair provisions for extensions for unavoidable causes and *force majeure*. The amount of water to be pumped in deep excavations or in the strata through which tunnels are driven is generally his responsibility, and settlements, due to pumping in the surrounding areas, if pumping in fact causes settlement in the subsoil (which often happens) is generally another heavy responsibility.

Over and above all this, the efficiency of his supervisory staff and of all his local employees in a foreign country far from his base are matters he has got to take into account in dealing with his valuation of the works. Nor must the consideration of the solvency of the employer be left out of his reckoning. The estimation of the cost of getting suitable raw materials for the structure for which he makes a price depends, for example, among other matters, upon the suitability of rock arising from local stratifications giving, in the case of a breakwater, the large category rubble which goes to build up such banks.

Then if he takes, as he often does in South America, payments in bonds or Government securities, he has to run the risk of a fall in the values of the medium by which he is paid.

I have not even now covered the whole of the possibilities of loss which assail the constructor of large engineering undertakings, either at home or abroad, and for which, after he has assessed to the best of his ability their values and the contingencies arising from them, he must make allowance first in the unit prices of the work he is called upon to do, and finally in the gross amount arrived at through the detailed computations. None of the foregoing suggestions are academic. They have all occurred more or less in my forty-five years' experience of doing work for public bodies, governments and private companies in connection with my firm at home and abroad.

There are some risks it clearly would be better for the employing authority to assume rather than he should place them on the contractor. I refer, of course, to those which cannot be attributed to the incapacity or neglect of the contractor himself. For example, taking the risks arising from sea action, unfavourable foundations, uncertain geology, excessive amounts of water necessitating heavy pumping, risks arising out of or due to war, and the adverse influence war or revolutions have upon commodity and labour prices : these are not things that with any amount of acumen on the part of the contractor can be provided for. If he adds to his estimate of cost sufficient to cover fully such possibilities, his estimates would probably be unduly high, and in that case the employing authority may have to pay for these risks not only what is in his estimate to cover them but on charges and profits upon these amounts in addition. Clearly it would be better for the employer, be it government, municipality or other-

wise, to guarantee that the borings taken and other data given are correct, that the water pumped shall be paid for at so much per gallons raised so many units in height, that should there be a cataclysm, either an earthquake or a sweeping away of the structure by unusual and heavy storms, quite uninsurable, then those things should be at the cost of the employing authority. In any event when the work is completed the employer gets the benefit of the overcoming of such risks and dangers and difficulties, therefore clearly he ought to pay for them and would be wise to pay only the nett cost. If he takes the responsibility for them on his own shoulders it will be cheaper for him rather than if the contractor includes sufficient to cover them in the prices for the work with profit added thereto. On the other hand, if the contractor has not allowed for and cannot face the loss, the employer will have to make a new bargain with some other contractor at much higher prices. The same may be said of the consequences arising from epidemics which again cannot be controlled by the contractor, although with proper sanitary organisation he may reduce them considerably.

The values of raw materials required for construction might be fixed with advantage to everybody, to be increased or reduced according to the rates of exchange. It is almost impossible for instance, for a contractor doing work in South America to ensure any specific price for coal or for cement and timber if required in large quantities over a period of many years, except with considerable margins. Clearly cheaper offers would be given for constructive works if a number of these risks were excluded, and no profits were attached or sums added to the tender prices to cover possible and indeterminate risks.

It might be thought, after this recital of the large risks contractors have to take, that they would of necessity come to grief sooner or later. That more do not reflects in a large measure their capacity to assess what these things mean, and their knowledge of the science of Economics. It is also well known that some, at least, die wealthy.

Few contracts are now entered into on what was the old-fashioned "lump sum" basis, where the contractor undertook to produce something that the employer considered he required and demanded to the satisfaction of himself and his engineer, whether, in fact, the drawings indicated the whole of what was thought to be wanted. The "lump sum" had to provide any finished result that was implied in the documents or specification, or that might arise out of the requirements of the specification, in spite of any possible error of judgement in the design or in the description of the physical characteristics or geology of the country in which the work was carried out.

Apart from the "lump sum" system, when all these risks have been considered and, as already stated, an estimate has been made of the actual values of labour and material based on knowledge of what such material could be got for in the locality where the work is to be done, there has to be added something for the uncertainties and contingencies that I have described, as well as for profit. The capital requirements for construction purposes vary according to the place and the character of the work. For a large engineering contract where big deposits are not called for, the capital required may easily run up to 15 per cent. of the gross cost. In other words, the maximum peak that may be reached before the earnings from work done (less retentions held by the Government or company) may be easily 15 per cent. above the receipts at that time, and possibly on a five years' job, between three and four years may elapse, the time varying according to the margin for profit, if such accrues before the contract receipts cross the line of expenditures. In diagrammatic form one has to compute what the interest will be on the average capital for the time before such desired result is achieved. Thereafter, capital, instead of having to be found, should flow into the coffers of the contractor, and therefore be on the credit side. The initial expenditure being as I have indicated, anything from, say, 12 to 15 per cent. of the gross cost of the work at a maximum peak, has got to be financed, either out of capital accumulated or by advance by some financial institution, and often a good deal of profit is sacrificed owing to the necessity of procuring these advances. If a contracting firm has three or four large contracts running at once, it may easily have to find either out of its own resources, or by borrowing, a sum approaching a million sterling. One contract may lose while another one gains, but with all the risks I have enumerated, and there are others which are not covered even by my long list, losses are often very heavy indeed. If these are not "shouted from the house tops" but are

borne with a grim determination and a mental "tightening of the belt," it is because contractors as a whole are a stoical people who prefer to keep their losses to themselves. I do not wish to discourage the young from venturing on the path that leads with hard work and luck to the summits that the successful contractor rises to, for the joys of fighting with nature and dealing successfully with the subtlety of man are the very breath of those who really give their life to this kind of work, and the pity of it is, in view of the confidence they have to show in themselves and others as well as in science and in nature, that the success they achieve in their adventuring, is sometimes far short of what they deserve.

My own great chief and partner, Lord Cowdray, was one of those who faced with great courage what might come, and never failed to complete anything he undertook, however severely he was called upon on some occasions to back his judgment and make good where nature or man had failed him. It may seem harsh to think or say, that he suffered more from man than he did from nature, but, whatever the obstacle, he ultimately triumphed to an unusual degree, and he deserved to, for his courage was phenomenal. No risk ever seemed to daunt him, and if after taking every precaution that forethought could suggest, the allowance he made were not sufficient, he faced the music without complaining.

I am the first contracting civil engineer who has been honoured by the British Association, and, therefore, I have thought that you would expect me to include some remarks on things I am specially conversant with, and this must be my excuse for having gone into so much detail on the economics of engineering construction.

It is obvious I have not attempted to deal with the influence which many sciences have upon engineering in its widest sense. It would appear unseemly, however, not to pay tribute to those sciences without which engineering cannot exist, the chief among them being physical and mechanical sciences and applied mathematics and all that those titles mean. They are subjects which have been enlarged upon before in addresses by your Past-Presidents and dealt with far more ably than I should feel it possible for me to do.

Another science that must not be forgotten in its connection with the raw materials that so largely enter into all engineering structural works is chemistry, the discoveries in connection with which have meant so much to the engineer.

Science, however, is being split up into so many different categories that there are many of this ever-growing group to which I have not paid sufficient, if any, tribute. My excuse must be lack of time to do them justice and not lack of appreciation of their helpfulness.

I have attempted to indicate the interdependence of the engineer on the science of the physiologist, the bacteriologist, the economist and the all-important science of finance, all of which enable the engineer to carry out his destiny by entering new paths and opening up, by the aid of railways and roads, vast areas to enable them to be made fruitful and suitable habitations for his fellows.

TANTALUM RARER THAN GOLD.

Tantalum is a rare element (says Chemicals), so rare, in fact that estimates indicate there is less tantalum than gold in the earth's crust, according to the United States Bureau of Mines, Department of Commerce. Next to tungsten, tantalum has the highest melting point and the lowest vapor pressure of all metallic elements. It is so unusually resistent to chemical corrosion that many acids that attack other metals do not affect it. Tantalum when heated above 350° will take up 740 times its own volume of hydrogen.

After remaing a laboratory curiosity for many years, tantalum was used to a limited extent and for relatively few years for incandescent electric-light-bulb filaments, says E. P. Youngman, in a report on tantalum and columbium just published by the Bureau of Mines. Interest in tantalum was again aroused when its electrolytic-valve action was discovered and taken advantage of in charging storage batteries, especially for radio work. Tantalum chargers were eventually displaced by other types of chargers but for a time they were manufactured in sufficiently large numbers to create a demand large enough to bring about its production on a commercial scale in the United States. As tantalum became available in larger quantities and at substantially lower prices, and as high prices for platinum encouraged the employment of tantalum as a substitute, the metal was put to many new uses.

THE COLOUR REACTION OF THE JAPANESE ACID CLAY TOWARDS HYDROCHLORIDE OF MALACHITE GREEN LEUCO BASE.

By NAOTO KAMEYAMA AND SHUMPEI OKA.

The authors have previously studied the nature of the so-called "oxidase-like" reaction of the Japanese acid clay, by using an aqueous solution of benzidine and an acidic aqueous solution of hydrochloride of malachite green leuco base, and concluded that in both cases the colour reactions are not really oxidase like but are due to some oxidising agents present in the clay, and furthermore, the oxidising agents in the above two cases are perhaps not the same.

Observed under a microscope, the Japanese acid clay is quite a heterogeneous mixture. The main part consists of translucent particles of light colour and irregular shape, mixed with other particles, brown flakes, transparent crystals, brownish-black grains, and few others. When the benzidine solution (basic) is added under a microscope, every particle of the main constituent is tinged gradually into blue. This is the first type of the oxidising reaction of the Japanese acid clay. On the contrary, when the acidic aqueous solution of hydrochloride of malachite green leuco base is used as a reagent, the colour reaction is quite heterogeneous; it starts at some brownish black granular particles, and the blue colour comes out of these grains gradually around into other parts, while every particle of the main constituent takes only faint green colour. This is the second type of tbe oxidising reaction. From these observations, it is most probable that the oxidising agent active for the first type reaction is equally distributed among the particles of the main constituent, while that for the second type reaction is concentrated in the brownish-black particles. It was found by analysis that the brownish black particles contained iron and manganese, perhaps in form of oxides. However, the authors could not determine exactly what compounds these oxidising agents were, because the amounts were too small to get enough samples for reliable analysis and only supposed that higher oxide or oxides of manganese played an important part.

Recently one of the authors had an opportunity to visit one of the Japanese clay-producing districts near Itoigawa. There he found that there are many thin layers or deposits of brownish-black substance bedded here and there in the original crude clay deposit and these brownish parts not being separated and discarded from the other part, were incorporated into the commercial product.

These brownish-black substances resembled in their colour and shapes the brownish-black particles mentioned above as the cause of malachite green oxidising agent, being present in the commercial Japanese acid clay. The confirmatory identification of these two substances was now done microscopically and by means of the oxidising reaction towards the acidic aqueous solution of hydrochloride of malachite green leuco base, and it was found out the two substances are one and the same substance. The brownish-black substance was carefully collected in the original field. The layer was so thin that it was impossible to get a sample without any contamination of some white particles. The sample thus obtained dissolved easily in concentrated hydrochloric acid, producing a brown solution with evolution of chlorine. This property and the systematic analysis of the sample showed that the substance consisted of an impure manganese dioxide containing much iron and other impurities, probably an impure pyrolusite or wad. The manganese content of the substance was determined with colorimetric method after being oxidised to permanganate, and was found to amount 13.3 per cent Mn for the wet substance.

From these results, the authors concluded that the oxidising property of the Japanese acid clay towards acidic reagents is due to the manganese dioxide contained in the brownish-black particles in it.

For another oxidising agent which being contained equally in every particle of the main constituent react towards the neutral or basic reagents, the authors supposed as follows : Just the same as usually considered in the case of other manganese dioxide deposit, this layer of manganese dioxide in the acid clay bed must be gradually precipitated along the water vein from the manganese containing underground water. Therefore it is highly probable that the manganese containing water goes slowly into the clay mass, and there deposited manganese on the surface of acid clay adsorbed in the form of salt of acid clay in minute quantity. Such manganese might be turned later into colloidal manganese dioxide when exposed to atmospheric oxygen. No doubt this colloidal

manganese dioxide is distributed on the surface of every particle of the acid clay substance, and is very active and can oxidise benzidine into the blue substance, but its amount is too small to produce intense colour reaction towards malachite green leuco base but shows only faint green colouration.

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AGRICULTURAL RESEARCH BUREAU.

The Imperial Agricultural Research Conference of 1927 recommended the establishment of clearing stations for information in eight branches of Agricultural Science—Soil Science, Animal Nutrition, Animal Health, Animal Genetics, Animal Parasitology, Plant Genetics (two branches) and Fruit Production. The proposal meets with general acceptance, subject to financial and administrative arrangements being evolved. The Governments of the United Kingdom, Canada, Australia, New Zealand, South Africa, India, together with the Colonial Office, on behalf of the colonies, protectorates and mandated territories, appointed representatives to prepare a scheme. Each government agreed to contribute to the upkeep of the bureau.

The first annual report is now issued covering the period from the 1st April, 1929 to 31st March, 1930. The year covered by the report was necessarily one of organisation, and a record of extensive work cannot be expected. The objective aimed at has, however, been attained, *viz.*, that of establishing machinery by which the officers of the Bureau can obtain direct contacts with research workers overseas. These latter are invited, when they visit the United Kingdom, to visit a bureau, each of which is placed at a well known research station, such as Rothamsted Experimental Station in Herts, the Rowett research Institute, Aberdeen; the Veterinary Laboratory Weybridge; the University of Edinburgh, the School of Agriculture Cambridge, the East Malling Research Station, Kent.

While the first annual report is a thin publication, recording the setting up of the necessary machinery, it may be expected that future reports will contain details as to what is being done. In the meantime, it is well to know that research workers in any of the countries mentioned can get into communication with one another through the Bureaux.

SEVENTY YEARS AGO.
(From the Chemical News, Jan. 21, 1860.)

ROYAL INSTITUTION OF GREAT BRITAIN.

A Course of Six Lectures (adapted to a Juvenile Auditory), consisting of Illustrations of the Various Forces of Matter, i.e., *of such as are called the Physical or Inorganic Forces—including an Account of their Relations to each other; by* M. Faraday, *D.C.L., F.R.S., Fullerian Professor of Chemistry, R.I., Foreign Associate of the Academy of Sciences, Paris, &c.*

Lecture III. (Jan. 4, 1860.) *Cohesion—Chemical Affinity.*

We will first of all return for a few minutes to one of the experiments which we made yesterday. You will remember what we put together on that occasion?—Powdered alum and warm water; here is one of those basins; nothing has been done to it since then, but you will find on examining it that it no longer contains any powder, but a multitude of beautiful crystals. Here also are the pieces of coke which I put into the other basin, these have a fine mass of crystals about them. That other basin I will leave as it is; I will not pour the water from it, because it will show you that the particles of alum have done something more than merely crystallise together. They have pushed the dirty matter from them, laying it around the outside or outer edge of the lower crystals—squeezed out as it were by the strong attraction which the particles of alum have for each other.

And now for another experiment. We have already gained a knowledge of the manner in which the particles of bodies—of solid bodies—attract each other, and we know that it makes calcareous spar, alum, forms. Now let me gradually lead your minds to a knowledge of the means we have of making this attraction alter a little in its force; either of increasing, or diminishing, or apparently of destroying it altogether. I will take this piece of iron [a rod of iron about two feet long and a quarter of an inch in diameter], it has at present a great deal of strength, due to its attraction of cohesion; but if Mr. Anderson will make part of this rod hot in the fire, we shall then find that it will become soft, just as sealing-wax will when heated, and we shall also find that the more it is heated the softer it becomes. Ah! but what does *soft* mean? Why, that the

attraction between the particles is so weakened that it is no longer sufficient to resist the power we bring to bear upon it. [Mr. Anderson handed to the Lecturer the iron rod, with one end red-hot, which he showed could be easily twisted about with a pair of pliers.] You see, I now find no difficulty in bending this end about how I like; whereas I cannot bend the cold part at all. And you know how the smith takes a piece of iron and heats it, in order to render it soft for his purpose; he acts upon our principle of lessening the adhesion of the particles, although he does not know exactly the terms in which we express it.

And now we have another point to examine; and this water is again a very good substance to take as an illustration (as philosophers we call it all water, even though it be in the form of ice or steam). Why is this water hard? [pointing to a block of ice] because the attraction of the particles to each other is sufficient to make them retain their place in opposition to force applied to it. But what happens when we make the ice warm? Why, in that case we diminish to such a large extent the power of attraction that the solid substance is destroyed altogether. Let me illustrate this: I will take a red-hot ball of iron [Mr. Anderson by means of a pair of tongs handed to the Leceurer a red-hot ball of iron, about two inches in diameter] because it will serve as a convenient source of heat [placing the red-hot iron in the centre of the block of ice]. You see I am now melting the ice where the iron touches it. You see the iron sinking into it, and while part of the solid water is becoming liquid, the heat of the ball is rapidly going off. A certain part of the water is actually rising in steam—the attraction of some of the particles is so much diminished that they cannot even hold together in the liquid form, but escape as vapour. At the same time you see I cannot melt all this ice by the heat contained in this ball. In the course of a very short time I shall find it quite cold.

Here is the water which we have produced by destroying some of the attraction which existed between the particles of the ice, for below a certain temperature the particles of water increase in their mutual attraction and become ice; and above a certain temperature the attraction decreases and the water becomes steam. And exactly the same thing takes place with platinum, and nearly every substance in nature; if the temperature is increased to a certain point it becomes liquid, and a further increase makes it gas. Is it not a glorious thing for us to look at the sea, the rivers, and so forth, and to know that this same body in the northern regions is all solid ice and icebergs, while here in a warmer climate it has its attraction of cohesion so much diminished as to be liquid water. Well, in diminishing this force of attraction between the particles of ice, we made use of another force, namely, that of *heat*, and I want you now to understand that this force of heat is always concerned when water passes from the solid to the liquid state. If I melt ice in *other* ways I cannot do without heat; (for we have the means of making ice liquid without heat; that is to say, without using heat as a *direct* cause). Suppose, for illustration, I make a vessel out of this piece of tin foil [bending the foil up into the shape of a dish]. I am making it metallic, because I want the heat which I am about to deal with to pass readily through it;—and I am going to pour a little water on this board, and then place the tin vessel on it. Now if I put some of this ice into the metal dish, and then proceed to make it liquid by any of the various means we have at our command, it still must take the necessary quantity of heat from something, and in this case it will take the heat from the tray, and from the water underneath, and from the other things round about. Well, a little salt added to the ice, has the power of causing it to melt, and we shall very shortly see the mixture become quite fluid, and then you will find that the water beneath will be frozen—frozen because it has been forced to give up that heat which is necessary to keep it in the liquid state, to the ice on becoming liquid. I remember once, when I was a boy, hearing of a trick in a country alehouse; the point was how to melt ice in a quart pot by the fire, and freeze it to the stool. Well, the way they did it was this; they put some pounded ice in a pewter pot, and added some salt to it, and the consequence was that when the salt was mixed with it the ice in the pot melted (they did not tell me anything about the salt, and they set the pot by the fire, just to make the result more mysterious), and in a short time the pot and the stool were frozen together, as we shall very shortly find it to be the case here, and all because salt has the power of lessening the attraction between the particles of ice. Here you see the tin dish is frozen to the board. I can even lift this little stool up by it.

GENERAL NOTES

THE POSITION WITH REGARD TO THE DECHEMA'S WORK ON STANDARDISATION.

The last semi-annual report of the Dechema, Deutsche Geselschaft fur chemisches Apparatewesen, General Office Seelze b. Hannover, on the position of its work of standardisation at the end of June, 1930, is able once more to indicate remarkable progress in the standardisation of chemical apparatus. Up to this date about 80 pamphlets had been issued on this subject by the various sub-committees.

In particular the especially important standardisation of apparatus for density determination, hydrometers and pyknometers, is now being undertaken in collaboration with other bodies engaged in standardisation work.

A series of pamphlets on the standardisation of rubber tubing, on the classification of laboratory glass according to its hydrolytic behaviour, and on rapid methods for the investigation of glass apparatus and filter paper is nearing completion. The pamphlets issued by the sub-committee for acid-resisting stoneware are at the moment being considered by the testing department of the German Standardisation Committee, and a series of further proposals for the standardisation of important stoneware apparatus has already been published in *Die Chemische Fabrik*, the organ of the Dechema.

At the Achema VI (this year's Exhibition of chemical apparatus organised by the Dechema) in Frankfort-on-the-Main, the Standardisation Committee of the Dechema was represented by a special exhibit which greatly impressed all those interested in this work.

VISIT OF H.M. COMMERCIAL AGENT IN BATAVIA.

The Department of Overseas Trade announces that Mr. H. A. N. Bluett, the British Commercial Agent at Batavia, will be available at the offices of the Department from 3rd November to 21st November for the purpose of interviewing firms interested in the export of British goods to the Netherlands East Indies.

Firms desiring interviews with Mr. Bluett in London should apply to the Comptroller-General, Department of Overseas Trade, 35, Old Queen Street, London, S.W.1., quoting the reference 481/1/30.

BRITISH INDUSTRIES FAIR CATALOGUE ARRANGEMENTS.

Ten thousand trade buyers on four continents will receive the overseas advance catalogue of the British Industries Fair, with index in their own languages, at least a month before the Fair opens in London and Birmingham on February 16 next. A later edition of 10,000 copies of the London catalogue will be handed out at Olympia to visitors from abroad and the home buyers' edition, on sale at the Fair, will run to 30,000 copies, making in all a guaranteed circulation of 50,000.

An advance edition of the catalogue of the Birmingham section of the Fair with index in nine languages is also to be circulated along with the London catalogue. Both are already in preparation. There are to be separate catalogues for the Cotton Textile Exhibition at the White City, London, February 16 to 28, and for the Artificial Silk Exhibition at the Albert Hall, London, February 16 to 21.

It is stated that in previous years the advance catalogue has brought orders and inquiries to exhibitors even before the opening of the Fair.

"The languages to be used both for the London and the Birmingham catalogues will be English, French, etc."

MERCHANDISE MARKS ENQUIRY.

Air and Gas Compressors: Pneumatic Tools and Appliances: and Parts.

The Standing Committee appointed by the Board of Trade will hold an enquiry at 11.30 a.m. on Monday, 24th November, and at 10.30 a.m. on Tuesday, 25th November, as to whether the undermentioned classes of imported goods should be required to bear an indication or origin :—

(1) Air and gass compressors and exhausters, and beds, casings, cylinders, rotors and heads therefor;

(2) Pneumatic tools and appliances, including mining coal cutters operated by compressed air, and cylinders, heads, piston and valves therefore.

The Enquiry will be held at the Board of Trade Offices, Great George Street, London, S.W.1. Communications should be addressed to the Secretary, Mr. E. W. Reardon at that address.

ONTARIO GOLD PRODUCTION.

According to a Bulletin issued by the Ontario Department of Mines, 324,993 tons of ore were milled in the Province in July with a total crude bullion recovery valued at $2,888,302, as compared with 347,114 tons of ore milled in July, 1929, with a bullion recovery worth $2,717,626.

Of the more recent total, the Porcupine field contributed 208,512 tons with a bullion recovery valued at $1,467,220, as compared with 258,011 tons and $1,549,104 in July, 1929. Producing mines in order of output were as follows :—Hollinger, McIntyre, Vipond, Coniaurum, March, Dome, and Porcupine United.

In the Kirkland Lake field, 101,917 tons of ore were milled as compared with 89,103 tons in the corresponding month last year. The crude bullion recovery rose from $1,165,124 to $1,365,743. Producing mines in order of output were as follows :—Lake Shore. Teck-Hughes, Wright-Hargreaves, Sylvanite, Kirkland Lake Gold, and Barry-Hollinger.

July receipts of crude bullion from Ontario at the Royal Mint, Ottawa, totalled 97,246 crude ounces containing 72,092 ounces of gold and 11,085 fine ounces of silver, having a total value of $1,494,003.

Steadily rising costs of coal delivered at According to an authoritative estimate, the output from the field should not be less than 100 tons of crude oil a day.

There are already between 11,000 and 17,000 tons of shale awaiting treatment. When the refining plant is reconditioned, a start will be made with refining this service An option on 11,000 acres of shale lands has been required.

GERMANY'S ECONOMIC PROBLEMS.

Present conditions in Germany can be explained best, perhaps, as the result of a check to over-rapid development, combined with the necessity of adjustment to a new and lower level of prices, writes the Commercial Counsellor at Berlin in his Annual Report. Meantime, however, despite an accumulation of domestic troubles, foreign trade has been satisfactorily maintained, and it is pointed out that reparation payments are helping to form valuable foreign connections which might not have been obtained otherwise.

Proceedings and Notices of Societies

THE CHEMICAL SOCIETY.

Thursday, October 30.

A General Method for the Preparation of Thiocyanine Dyes. Some Simple Thiocarbocyanines. By N. I. FISHER AND F. M. HAMER.

Thiocyanines were first prepared by Mills by two methods, but the yield is, at best, only 21 per cent., and the dye is always accompanied by the corresponding thiocarbocyanine; he established the constitution of thiocyanine by a synthesis. The present method consists in heating a benzthiazolinium chloride, containing a reactive methyl group, with amyl nitrite in the presence of acetic anhydride; the method is a general one, and the yields of crude thiocyanines, which are unaccompanied by other dyes, vary from 35 to 48 per cent., being 18-33 per cent. after recrystallisation. From 1-methylbenzthiazole ethochloride was prepared 2 : 2′-*diethylthiocyanine chloride*, which was converted into the corresponding *bromide* and iodide. Similarly, 2 : 2′-dimethylthiocyanine chloride was prepared, and was converted into the *bromide* and iodide. These iodides proved identical with specimens prepared by Mills's method. From the ethochloride and methochloride of 1-methyl-α-naphthathiazole were prepared 2 : 2′-*diethyl-5 : 6 : 5′ : 6′-dibenzthiocyanine chloride* and the corresponding *dimethyl compound;* they were converted into the *bromides* and *iodides*. The quaternary salts of 2-methyl-β-naphthathiazole did not yield thiocyanines. Thiocyanines could not be prepared from 2 : 4-dimethylthiazole ethochloride and methochloride; the corresponding ethiodides gave the simple thiocarbocyanines by the pyridine and ethyl orthoformate method, but the yields were abnormally low. These thiocarbocyanines are particularly interesting because their optical properties are so unexpected.

Stereochemical influences on Aromatic Substitution : Substitution Derivatives of 5-Hydroxyhydrindene. By W. H. MILLS AND I. G. NIXON.

Whereas *ar*-tetrahydro-β-naphthol reacts with aromatic diazo-compounds or with bromine to give chiefly 2-substitution derivatives (Schroeter), 5-hydroxyhydrindene gives with these reagents chiefly 6-derivatives.

This difference in behaviour is referred to the different arrangements of the benzene linking systems in the two compounds. It is suggested that these arrangements are such that the linking common to the two rings consists of a double linking in the stable form of the tetrahydronaphthol and a single linking in that of the hydroxyhydrindene, and that these arrangements are those which give least intra-annular strain in the alicyclic rings.

Syntheses with ββ'-Dichlorodiethyl ether. Part II. Heterocyclic Compounds Containing Two Atoms of the Oxygen Group in the Ring. 1 : 4-Selenoxan and Its Derivatives. By C. S. GIBSON AND J. D. A. JOHNSON.

1 : 4-Selenoxan, a colourless liquid, b.p. 66°/22 mm., has been prepared by the action of sodium selenide on ββ'-dichlorodiethyl ether. The parachor has been determined by Dr. S. Sugden, who finds that the observed value (245.2) agrees very closely with that calculated (244.6).

1 : 4-Selenoxan possesses strong additive properties, combining with the halogens to give dihalides, and also forming a methiodide, mercurichloride, and chloroplatinate. The dichloride with moist silver oxide yields a hydroxide which has not been obtained in the crystalline condition; from this, by the action of concentrated nitric acid, a nitrate has been prepared. The dichloride and dibromide react with ammonia in benzene solution, yielding additive compounds, that from the dibromide having the composition, $O(C_2H_4)_2SeBr_2(NH_3)_2$. The analogies existing between 1 : 4-selenoxan and other heterocyclic selenium componnds and the bearing of these results on the valency problem are discussed.

NOTICES OF BOOKS.

Glass. By DR. F. H. ZSCHACKE. Pp. xvi + 208. Dresden and Leipzig : Theodor Steinkopff. 1930. Price 12 marks.

Dr. Zschacke has written an important technological work dealing with the glass industry, from a study of the raw materials, through the various stages of manufacture to the finished products. A *Foreword* has been written by Dr. F. Eckert, glass technologist at the Berlin Technical School, who emphasises the changes that have taken place in glass-making since the war. The extensive developments of mechanical manufacture of glass vessels by mass production methods has reacted not only on the engineering side of the industry but has introduced modifications into the chemical composition and working of the materials.

The present volume deals fully with the physical and physico-chemical phenomena associated with glass and its production, the difficulties and causes of flaws and their avoidance, the crystallisation of silicates, the chemical nature and constitution of glass and its analysis.

The book is, in many ways, an important one and can be cordially recommended to all concerned with the glass industry.

The Gypsum Industry of Canada. By L. H. COLE. Pp. viii + 164. Ottawa. Department of Mines. 1930. Price 30c.

This compilation, with maps and illustrations, gives an authoritative survey of Canada's Gypsum industry which is one of the Dominion's most important non-metallic mining undertakings. Canada is the third largest producer of gypsum and in 1928 produced over a million tons valued at over 3 million dollars, the greater part being exported, chiefly to the U.S.A.

The deposits in Nova Scotia are the most extensive and most productive and working dates back to 1770.

The various sources and methods of mining and the mill flow sheets are given in detail and for those in any way connected with the use of gypsum and the products formed from it, will find the present monograph of special interest.

Postal Reform. By EDWIN WELLS. Pp. 61. London : The C. W. Daniel Company, 46, Bernard Street, W.C.1. 1930. Price 1s.

The book is an elaboration and elucidation of a scheme of postal reform formulated into a series of articles. Requests for further articles, coupled with numerous inquiries from friends, prompted the author to restate the case for Mid-day Letters—that is to say, a revision of postage under which the four present classes of correspondence : (1) Letters; (2) Postcards; (3) Printed Papers; and (4) Late halfpenny matter — would be replaced by two :—Ordinary : postable at any hour and treated the same as letters are at present; and Midday : postable between 8.30 a.m. and 3 p.m. and normally falling into the second delivery.

The author shows that inland postal rate in this country are in essence the same to-day as they were three generations ago; that practically all postal matter is still treated as though it was equally urgent or non-urgent, despite the ever-increasing proportion of non-urgent correspondence; and that as a result there are two great bursts

of postal activity—one in the early morning and the other in the evening—besides much night work.

A notable fact, brought to light for the first time in this book, is that during the present period of oppressive taxation, the Post Office is actually losing about a million pounds a year on halfpenny postal matter.

Forthcoming Events.

THE PHYSICAL SOCIETY.

Friday, November 7, at 5 p.m., at the Imperial College of Science, Imperial Institute Road, South Kensington.—Ordinary Meeting.

THE OPTICAL SOCIETY.

1, Lowther Gardens, Exhibition Road, London, S.W.7.

Thursday, November 13, at 7.30 p.m., in the Imperial College of Science and Technology, Imperial Institute Road, South Kensington.—Ordinary Meeting.

ROYAL INSTITUTION.

21, Albemarle Street, W.1.

Thursday, November 13, at 5.15 p.m.—"The Physiology of Water." By J. B. S. Haldane, M.A.

Saturdays, November 8, and 15.—"Some Recent Archæological Work in Italy." By A. Hamilton Smith, C.B., M.A., F.B.A.

THE INSTITUTE OF METALS.

SHEFFIELD LOCAL SECTION.

Friday, November 14, at 7.30 p.m., in the Non-Ferrous Section of the Applied Science Department of the University, St. George's Square. "Unsoundness in Metals." By H. Hyman, Ph.D.

THE SIXTH ANNUAL NORMAN LOCKYER LECTURE.

"Science and Modern Industry," is the subject of the Norman Lockyer Lecture, 1930, which will be given by Professor Sir William Pope, K.B.E., D.Sc., F.R.S., in the Goldsmith's Hall, Foster Lane, London, E.C.4. (by permission of the Goldsmiths' Company) on Thursday, November 13, 1930, at 4.30 p.m.

The Rt. Hon. Sir Samuel Hoare, Bart., will take the chair at the Lecture.

There will be no charge for admission to the Lecture, tickets for which may be obtained on application to the British Science Guild, 6, John Street, Adelphi, London, W.C.2.

ROYAL SOCIETY OF ARTS.

John Street, Adelphi, London, W.C.2.

Wednesday, November 12, at 8 p.m.—Professor Albert E. Richardson, F.S.A., F.R.I.B.A.: "The Royal Society of Arts Competition of Industrial Designs." The Right Hon. Lord Stanmore, C.V.O., will preside.

ROYAL INSTITUTE OF PUBLIC HEALTH.

Wednesday, November 12, at 4 p.m., in the Lecture Hall of the Institute, 37, Russell Square, W.C.1.: "The Importance of a Complete Study of the Nutritional Value of Milk." By R. Stenhouse Williams, M.B., D.Sc., D.P.H.

THE INSTITUTE OF METALS.

- SCOTTISH LOCAL SECTION.

Monday, November 10, at 7.30 p.m., in the Rooms of the Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank Crescent, Glasgow: "The Applications of High-Nickel, Nickel-Copper Alloys and Pure Nickel in Industry." Illustrated by cinematograph film.

UNIVERSITY OF LONDON, UNIVERSITY COLLEGE.

Gower Street, W.C.1.

Monday, November 10, at 5 p.m.—"The Respiratory Functions of the Blood." First of a course of four public lectures by Dr. L. E. Bayliss. November 10, 17, 24 and December 1.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

31,138.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of products containing nitrogen. October 17.

31,184.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of aromatic compounds containing nitrogen. Oct. 17.

31,185.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of 1 : 4 : 5 : 8 :-Naphthalene-tetra-carboxylic acid and derivatives thereof. October 17.

Specifications Published.

336,237.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of neutral polymerisation products from vinyl esters.

317,854.—Naamlooze Vennootschap Fabriek Van Chemische Producten.—Manufacture of highly esterified acetyl-nitro-cellulose.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

ZIMSTA.

505,330.—Chemical substances used in photography.—Frank Harry Stacey, trading as F. H. Stacey, 28, Grove Road, North Finchley, London, N.12. October 20.

SUNNICENE.

506,176.—Chemical substances for use in manufacture in the finishing of textile fabrics.—R. Chitchley, Ltd., Regent Soap Works, Comus Street, Salford, Manchester. October 22.

DUOVANIL.

515,895.—Chemical substances used in manufactures, photography or philosophical research, and anti-corrosives.—W. J. Bush & Co., Ltd., 28, Ash Grove, Hackney, London, E.8. October 22. (Associated.)

TRIANO.

515,000.—Chemical substances for use in and as aids to dyeing in the course of manufacture of textile fabrics and leather.—H. Th. Bohme Aktiengesellschaft, 29, Mortizstrasse, Chemnitz, Saxony, Germany. Oct. 22.

GRAMMAR OF LOGIC.

100 Questions and Answers on The Grammar of Logic or How to Reason Correctly. By J. E. Roscoe, M.A., Oxon.

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BRICK KILN PATENT FOR DISPOSAL.

Mr. V. Lastovicka, of the Japan and China Trading Co., 56, Rasin Embankment, Prague, Czechoslovakia, is open to receive offers for the exploitation of his patented "Tunnel" Brick Kiln Construction in Great Britain and Dominions and Colonies.

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SOME ORGANIC COMPOUNDS OF THALLIUM.

By DR. R. C. MENZIES.

(*Paper read at the British Association Meeting, Bristol, September 9.*)

The thallous atom, in virtue of its strongly electropositive nature, replaces the hydrogen atoms of many hydroxy compounds—including simple and polyhydric alcohols of the aliphatic series—with formation of stable compounds, which are generally less soluble than those of the alkali metals and consequently more easily prepared.

In many cases, all the hydroxyl hydrogen atoms of polyhydric alcohols can be thus replaced, dithallium ethylene glycol, trithallium glycerol, tetrathallium erythritol, and hexathallium sorbitol being cases in point.

The hydroxyl hydrogen of hydroxy acids can also be replaced by thallium as well as the carboxyl hydrogen, dithallium glycollate, tetrathallium d-tartrate, tetdathallium meso-tartrate, and hexathallium gluconate having been prepared by treating the corresponding acids or their normal thallium salts with the necessary excess of aqueous thallous hydroxide solution.

Well-defined thallium salts of the reducing sugars have not yet been prepared owing to the reduction of the metal with oxidation of the sugars and consequent formation of mixtures of oxidation products.

Methyl arabinoside, however, and α and β-methyl glucosides and sucrose in which the reducing groups are protected, all give well-defined thallium derivatives, forming respectively trithallium methyl arabinoside, trithallium α- and trithallium β-methyl glucoside, and tetrathallium sucrose. It will be noticed that while all three of the replaceable hydrogens in methyl arabinoside can be exchanged for thallium, in the case of the methyl glucosides one of the four available hydrogens escapes replacement, while sucrose on treatment with varying quantities of thallous hydroxide yields tetrathallium sucrose in which four only of the eight available hydrogen atoms are replaced.

An explanation of these observations, which it is hoped to extend to other sugars, has not yet been found, although it is significant that while tetrathallium tartrate is easily prepared, the dimethyl thallium radical, which must take up more space than the thallium atom only forms a tridimethyl thallium tartrate.

Beginning with the simplest cases, attention may be called to Sidgwick's and Sutton's recent paper showing that thallous ethoxide has in benzene solution a fourfold molecular weight, and to their suggestion that the thallium and oxygen atoms may be arranged at alternate corners of a cube, the ethyl groups being attached, naturally, to the oxygen atoms. If one of the β-hydrogen atoms in each ethyl group be now replaced by OTl, a *possible configuration* for the thallium salt of ethylene glycol is seen to be an arrangement of cubes having oxygen and thallium atoms at alternate corners, each oxygen atom being joined to the oxygen atom at the corner of the adjacent cube by the group—$CH_2.CH_2$—. This suggestion is, of course, put forward with all reserve.

But the writer is of opinion that before any explanation of the results outlined above can be forthcoming, it is necessary to explain the *differences between thallous* ethoxide and dithallium ethylene glycol, which are striking. He would welcome further suggestions.

BRITISH TAR FOR BRITISH ROADS.

It has been stated recently that the country's future prosperity is fundamentally wrapped up in the increased use of coal. Now the gas industry forms one of the largest groups of coal consumers in the country, using more than 18,000,000 tons annually and incidentally supplying the electrical undertakings with power in the form of coke. The disposal of its by-products is essential to the economic development of the industry and at the same time of direct importance to the country's well-being.

Tar is one of the principal of these by-products of the gas works and on its sale at a fair price depends to a considerable extent the price of gas to the consumer.

Time and time again British tar of standard specification as well as proprietary tar preparations have been shown to be equal, if not superior, to all other forms of road dressing. These provide hard-wearing surfaces, with good grip for motor traffic, and they are not expensive. Is it too much to ask, therefore, that good quality tar should be more generally used instead of materials of foreign origin?

THE CAUSE OF SLEEPING-SICKNESS. THE TSETSE-FLY IN SOUTH AFRICA.

By C. C. Mossop, M.Sc.
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To bring together and to set briefly before the public some of our knowledge and theories concerning tsetse-flies in South Africa is the object of this paper. The available literature for such a purpose is meagre, and the accumulated work on tsetse-flies in various parts of Africa has been drawn upon to fill in gaps and to attempt to answer some questions which arise. It should be understood, however, that there are about twenty species of tsetse-flies, known, and in many respects their habits differ. Our own problem almost entirely concerns but one of these. Furthermore, a very large portion of the foreign literature has arisen from the desire of man to combat the human sleeping-sickness menace, whilst at present we in the Union of South Africa have only "nagana," or trypanosomiasis, or sleeping-sickness in cattle, with which to deal.

The Flies.

As far as is known, the only tsetse-infected areas within the Union of South Africa to-day are in Zululand. Concerning the Transvaal, Fuller (1923) writes: "One cannot assert positively that the fly is entirely absent from the Transvaal, because it so happens that many of the more recent fly-haunts are still out of the beaten track, and no entomologist has made a particular search for fly in any one of them. On the other hand, the fact remains that since the rinderpest no one claims to have seen fly nor has a case of nagana been reported; further, that cattle and horses are taken anywhere without heed of nagana."

The common tsetse of Zululand is *Glossina pallidipes*. One specimen of *Glossina austini* and a number of *Glossina brevipalpis* have also been found. Principally *G. pallidipes* is referred to in this paper, but what is said of other tsetses is often equally true of this one. Thus, *G. pallidipes*, in common with all other tsetse-flies, may be recognised as a tsetse by the position of the proboscis or "beak" when not in use, and the characteristic folding of the wings when at rest. In the resting fly the proboscis projects *forward* from the lower portion of the head, and the wings lie *flat* along the back, lying one over the other like the flat blades of

closed sheap-shears of the scissors type. Other flies may have one or the other of these characters, but tsetse-flies alone have both. The wings of dead tsetses do not usually retain the position as described above. Roughly, the flies of the three species mentioned, when normally resting, appear darkish-brown to grey, for the wings conceal the paler abdominal markings. Of the three, *G. pallidipes* measures about two-fifths of an inch, excluding the wings and proboscis, *brevipalpis* is slightly larger, and *austeni* slightly smaller. Croveri (1919) considers the average life of *G. pallidipes* to be three months, while Harris (1926) in the laboratory obtained a *maximum* of five and a half months for females and six months for males.

A fundamental difference between the development of the tsetse-fly and that of most other insects was first pointed out by Sir David Bruce (1895). He observed that the female fly does not deposit her eggs, but retains them within her body. The larvæ develop one at a time within the body of the parent fly, not being extruded normally before they are fully grown. Their nourishment is derived from the mother during their intrauterine existence. Harris' record (1926) shows the period of gestation of *G. pallidipes* to vary from nine days to three weeks, depending on the season, and that on an average the female deposits her first larva about 29 days after her emergence from the resting or pupal stage. With regard to the same tsetse, Croveri (1919), in Italian Somaliland, found that the female can produce seven to ten larvæ during her life at intervals of 10 to 11 days. Such a birth-rate is extraordinarily low for insects. The maximum number of larvæ obtained from one female by Harris in Zululand was nine, and one mating was sufficient for the production of four larvæ. One of his laboratory bred female flies during the 67 days of her life deposited three larvæ and fed only ten times. As his laboratory conditions were conducive to inactivity on the part of the flies, however, the present writer is of opinion that in nature such an occurrence would be extremely rare.

The appearance of gravid female tsetse-flies has been described by various writers, but suffice it to say that the first signs of pregnancy can be seen on the underside of the engorged female, where a small pale patch can be observed near the posterior extremity; this patch grows as the larva develops, until the abdomen of the parent is greatly swollen. When fully grown the larva is deposited—usually on the ground. "The act of birth," says Harris, "is usually rapid." Jack (1919) states that "We know little enough concerning the factors that induce the fly to breed, but we do know that regular meals are necessary to the insect in confinement, and it seems almost probable that a state of semi-starvation in nature would either cause the insects to cease breeding, or that pregnant femals, with growing larvæ draining their vitality, would tend to die off or abort in such circumstances.

The Trypanosomes and Their Transmission.

The causative organisms or "germs" of nagana and sleeping-sickness, and other trypanisomiases, are protozoa of the genus *Trypanisoma*, not visible to the unaided eye, but existing in large number in the blood of certain wild animals without apparent injury to these hosts. In domestic animals and man, however, certain of them set up disease. Some of these trypanosomes are taken into the alimentary canal of the tsetse-flies, which feed on the blood of an infected host and undergo a cycle of development and increase within the insect. Large numbers are later injected into other animals on which the flies may feed. According to Lloyd, Johnson, Young, and Morrison (1924), the infection of *G. tachinoides* and *G. Morsitans* with the trypanosome species *vivax* and *congolense* "bears a close relation to the amount of blood obtained from antelope, and consequently *morsitans* is in general nearly four times as heavily infected as *tachinoides*." It should be explained that in certain seasons *G. tachinoides* largely feeds from reptiles. The trypanosomes commonly encountered in Zululand are *T. congolense*, *T. brucei*, and *T. vivax;* these cause nagana but not human sleeping-sickness. Probably every one who has worked in the field with tsetse-flies carrying trypanosomes has had thousands of the organisms injected into his blood, yet in Zululand sleeping-sickness is not known to occur.

The Following Habit—Proportion of Sexes.

Adult tsetses are active and swift, and their tendency to follow game and other moving objects is well known. The present writer believes that attraction by a moving object is the result of the nature of the tsetse's eyesight, coupled with its desire to find food or a mate. The eyesight is poor

in that the fly cannot recognise form, though in the detection of movement the eyes of the tsetse are exceedingy acute. But in a following swarm of flies the insects fly about the object without apparent intention to settle. Harris (1926) explains that the flies find " difficulty in alighting on the legs, their usual place, and thus a collection of flies is formed, such as might be called a following swarm." His observations were made on *G. pallidipes*, and the tendency of this fly to follow would seem to be confined to a bush environment and its immediate vicinity. Curson (1923), also writing of *G. pallidipes*, states that tsetses will very seldom follow their hosts into the open, the number of following flies decreasing as the distance from their bush habitat is increased.

Harris further writes: " *Glossina pallidipes* is not a tenacious follower either of man or quadrupeds, unless very hungry, and the persistency of the fly is in proportion to its degree of hunger. On the other hand my experience is that the very hungry fly which fails in its efforts to feed on the moving animal will continue to try." He mentions an occasion when a female followed a party through a mile of bush, and another occasion where " a male kept with the party for half-a-mile." In open country he once observed a fly to follow for 900 yards. The same writer says: " Sometimes I observed buzzing flies leave a moving bait-animal when the bush through which I had been travelling merged into open country. I am certain that there is aversion on the part of the tsetse fly voluntarily to venture far into the open. The explanation, I offer, is that the mass of the bush exhibits greater attractiveness to those flies which have not alighted on an object than the object itself."

Male tsetse, according to most authors, are far more active than the females. This is probably true of *G. pallidipes*, and is known to be true of various other tsetses. The females of these other species at least are of a retiring nature, hiding away when not actually engaged in a feeding expedition. The males, on the other hand, must find their mates as well as their meals, and numerous authors have shown that under normal conditions of game, the percentage of adult males caught at a moving object considerably exceeds that of females. This phenomenon is explained by the observation that males will very often come to a host without intent to feed, but for the sole purpose of finding a mate. The females, on the other hand, will hide in a secluded, shady place, and fly out when hunger demands.

FEEDING.

The proboscis of the tsetse-fly, as has been stated, projects forward from the head. It is, however, enclosed between the paired palpi, which are usually what one actually sees when examining the fly with the unaided eye. When the fly is about to feed, it raises the palpi somewhat and swings the fine, amber, needle-like proboscis down to a position at a right angle with its body and pierces the skin of its host. Perforation is not always effected immediately, as the fly may explore a considerable area of skin before finally piercing. If a suitable blood-stream be not immediately tapped, the fly may partly withdraw its proboscis again and again and each time thrust it in a new direction, or it may withdraw it completely, and puncture the skin elsewhere. When a suitable site has been located, the blood can be seen in the proboscis as it flows from host to insect.

Harris (1926) has stated that " the pumping action in the proboscis of a tsetse-fly commences immediately the organ is lowered and before actual penetration has taken place," and again, " hungry flies which bite into any surface would by the automatic pumping action of the proboscis necessarily take up some liquid if any happened to be present." If this were so the observation would be of inestimable value as affording a means of killing the fly by dipping host animals in poison solutions. But Fuller and Mossop (1928) came to the conclusion that " in the operation of probing . . . . no moisture upon the surface of the skin can be taken into the alimentary tract," and that feeding is under the psychic control of the insect.

The method by which blood is transfused from host to insect is not understood. Harris, as quoted above, writes of " the " pumping action of the proboscis." Newstead (1924) describes and illustrates a " sucking stomach " in the abdomen of the tsetse-fly, though he does not say that it exerts any sucking action. For a time, the resent writer held the opinion that the pressure of the blood within the host, even the very low but positive pressure in the blood of recently killed animals, was responsible for the inflow. As described by Fuller and Mossop (1928), he tried to show this by cutting off the abdomens of several *pallidipes*, thereby removing their " sucking

stomachs." The flies then "fed" on him, globules of blood dropping from their thoraces. Capillary action was possibly responsible, but more likely than that, blood pressure. However, the writer is not in a position to contradict the considered statements of Rodhain, Pons, Van den Branden, and Bequaert (1913), whose experiments with *G. morsitans* convinced them that "it is not necessary that the liquid upon which it is feeding should be subject to positive pressure." In the absence of opportunity on the part of the present writer for immediate further experiment and study, the suggestion is now tentatively made that sucking may be a function of the oesophageal valve in tsetses.

Whatever the mechanism of feeding may be, the fact remains that tsetse-flies engorge themselves to a remarkable extent. When a fly is feeding, the usually flattened abdomen becomes distended below, the blood showing red through the body wall, until the abdomen would seem about to burst. This habit would suggest that in the evolution of their species, tsetses have not enjoyed a regular and easily obtained supply of food. Nevertheless, they cannot live, as some insects do, for protracted periods without food. Harris (1926) suggests the maximum period of starvation as twelve days. The blood of wild animals, and, as far as *G. pallidipes* is concerned, probably of mammals and birds only, constitutes the food supply of tsetses. The theory that the flies can subsist on a vegetable diet is not proven; moreover, it is largely discounted.

Feeding and other activities are confined practically to daylight hours, especially the morning and evening. *G. pallidipes*, however, has been known to attack at night when the moon was bright, or when there were other sources of illumination. It is even credited with attack by starlight.

BREEDING PLACES OF TSETSE-FLIES.

In Zululand the puparia of *G. pallidipes* are found mostly in thickets. Harris (1926) identifies the following four types of breeding places :—

Single large clumps of evergreen bushes.

Clumps of bushes and trees on the banks of a stream.

Thickets growing amongst rocks and boulders.

Small evergreen bushes amongst clean-stemmed trees which throw overhead shade from their branches when in foliage.

In the above it will be noticed that there is no mention of water in the neighbourhood, except in the second type of locality. In fact the same writer discloses that fresh puparia were collected up to seven miles from the nearest water during a period of drought. The importance of water would appear to be purely secondary, in that it provides a centre to which host animals are attracted, and in that it is usually accompanied by shady bush. The above author sums up as follows :—

"Of many descriptions of breeding places which I have in my notes, almost all have the following characteristics, namely-checkered shade, light friable soil, leaf carpet, dry situation, a game path alongside or adjacent, and on one or more sides an open aspect facing no particular direction."

He later goes on to say : "Whereas I frequently found at either side of a game track, what appeared to be situations with all factors common, the clump of bushes on side would yield a number of puparia and shells, while the opposite clump yielded nothing, or one clump might have puparia and the other only old shells . . . Thinking at first that it might be due to the one clump of bushes being more favoured than the other as the standing or lying place of some animal, I made careful search of the soil for evidence of spoor but without success. Subsequent, however, to concluding that the fly depends very largely on sight, and is attracted to the edge of the shadow of conspicuous objects, I became convinced that what leads the female to drop her larva on one side of a bush rather than the other is the difference in the lighting of the two places. . . . The use of a breeding place certainly varies with the time of the year, and in my experience the finding of a large number of shells in any one spot and a large number of puparia in another hard by was correlated with altered conspicuousness, the places where the shells only were found having temporarily lost in large degree the apparent attractive characteristics."

Harris' theory, and a discovery made by Swynnerton in Tanganyika Territory, are hardly in keeping. Swynnerton (1923) found a few puparia of *G. pallidipes*, along with those of *morsitans*, in an unshaded game playground. To make the theory agree with the discovery it must be assumed that the larvæ were dropped in the shade of herds of game standing in certain conditions of light. At any rate, Swynnerton remarks

that: "A point of no little importance is that a high proportion of the puparia found in the open were dead."

Croveri (1919), in addition to finding puparia of *G. pallidipes* in the usual shady localities, found them among the roots of trees and under banana trees in Italian Somaliland. Harris, in Zululand, was unable to find puparia "in the sand in the beds of the smaller streams beneath the overhanging shade of the fringing bushes . . . though puparia were found in the humus beneath the bushes on the banks." It would seem then that soil plays a part in the choice of breeding grounds. In good breeding-places more shells and shell fragments than live pupæ were usually found by Harris—"evidence that the older shells are *an accumulation over considerable periods*." As a result of direct experiment, he found that 50 per cent. of the pupal shells were easily recognisable as such after being buried for two years.

TSETSE AND THE SMALLER ANIMALS.

For purposes of discussion as possible hosts of tsetse, wild animals are usually separated into two main divisions, smaller animals, and big game, the carnivors being included with the smaller animals, which we shall consider first.

Croveri (1919), although he was unable to find reptilian blood in flies taken in the field, suggests that crocodiles are a possible supplementary source of blood for *G. pallidipes*. Previously, however, Lloyd (1914) in Northern Rhodesia, had shown that "Reptilian blood is not suitable to *G. morsitans* as a continued diet."

Concerning bird hosts, Lloyd continues: "Mammalian blood has a slight advantage over avian as a diet, and this is shown by the larger average size of the pupae produced in the laboratory." He states that the blood of birds is liable to form a clot in the "'sucking stomach" of the fly, with resultant distortion of some of the eggs. However, in numbers of pupæ produced by the fly, ". . . mammalian blood has no definite advantage over avian." Harris (1926) in an experiment with rather a small number of *G. pallidipes* feeding on a fowl, remarks: "The small number of larvæ obtained in the test is remarkable and is thought to signify unsuitability of the blood of a fowl for the perpetuation of the species," and, "The resultant puparia had a decided reddish appearance, and did not attain the almost black tone of normal puparia." With regard to the same fl-

Curson (1923) says: "In the case of vultures, tsetse have been noted hovering about the region of the head on two occasions." Jack (1914) observed that "the tsetse's habit of awaiting its prey not far from the ground renders it probable that the vast majority of birds come comparatively rarely within the ken of the fly. Small birds, also, in addition to their restlessness, activity and tendency to catch insects, probably have but little power of attracting tsetse." He concludes that there is "some ground for belief that for some constitutional cause, such as their conformation, their armature of feathers, their activity, their habit of pecking at insects, or such causes combined, birds as a class do not form a very suitable source of sustenance to tsetse." Contemplating the possible counter-attack of avian hosts, Lloyd (1914) placed a fowl in a large cage (36in. by 18in. by 18in.) and introduced 20 *G. morsitans*. "The fowl was well supplied with food, but by the following morning all the flies had been eaten."

As a result of incidental tests, Harris (1926) suggests that "there is no inclination on the part of *G. pallidipes* to feed on fruit, reptiles, caterpillars or such small animals as cane-rats." Jack, in his paper above referred to, writes of tsetse-fly in Southern Rhodesia at a time when *G. morsitans* was the only known species of tsetse in that country:—

"The smaller lizards including the chameleons, are more likely to make a meal of tsetse than *vice versa*, whilst the terrestrial tortoises are too scarce to be of any account. Amongst the mammals, certain orders, namely the Insectivora, Chiroptera and Edentata, are obviously of no service on account of their nocturnal habits and the seclusion of their diurnal retreats. Certain rodents, such as hares, may serve the fly for a meal on occasions, but the order can be of little importance on account of the small size and activity of the majority of its members and the fact that they are largely nocturnal in habit. Of the larger species the porcupine (*Hystrix*) is entirely nocturnal, but certain squirrels attain a size not greatly inferior to that of a rabbit and are of diurnal habit. The larger forms of the latter family are, however, rarely seen in country suited to the tsetse. No doubt the larger Carnivora are attacked by tsetse when they enter its haunts, but their number are so relatively small that they

are practically negligible. Lions and, to a lesser extent, hyænas, are also dependent on the larger ungulates for food, and desert country from which these have been driven. The hunting dog (*Lycaon*) is always migratory, and leopards and jackals, in addition to their scarcity, lie up during the day. The smaller Carnivora—FELIDAE, VIVERRIDAE, MUSTELIDAE — are also practically nocturnal, and from their alert and active habits are unlikely to submit to be fed upon. Anyone may note the intolerance of the domestic cat to the attention of *Stomoxys* in this connection. It would seem, therefore, that the whole class of mammalia, with the exception of ungulates and certain primates, are little fitted to be of service to tsetse even in the aggregate."

TSETSE AND BIG GAME.

The disappearance of the fly as a result of civilisation is known to be usual. Similarly, the disappearance of the fly as a result of rinderpest is known to be usual. The obvious common factor here is the reduction of the big game. This factor and fly disappearance may, it is true, be coincidental, for each of the above-mentioned circumstances of fly disappearance may have included inimicable factors other than big game reduction. For instance, the blood of rinderpest-infected animals may have been harmful to the fly; Duke (1919) has shown that this is not so with *G. palpalis* in Uganda. Again, rinderpest may have been coincident with adverse meterological conditions; Jack (1919) produces evidence that "would seem to dispose effectively of the theory." Further, the advance of civilisation changes the habits and habitats of the game, making the animals more wary, and inducing nocturnal habits in many of them; but this represents merely an increased scarcity of game as far as the fly is concerned, and would fall into the same category as the reduction of game.

ENEMIES OF TSETSE-FLY.

Apart from man, the known enemies of tsetse include insects and other animals *predaceous* on the fly in any of its stages of existence, and also insects and lower organisms which *parasitise* the pest. Austen and Hegh (1922) include *indirect* enemies, animals such as carnivors and certain biting flies, which may control the number of favoured hosts in a locality by killing, by harassing, or by both means.

Numerous experiments to ascertain the possibility of controlling tsetse by means of predators and parasite have been carried out in various parts of Africa, but up to the present encouraging resuts have not been forthcoming. As the fly is practically confined to Africa, the known enemies are also African and are, under their natural conditions, not realising the control required. The introduction of known enemies to new areas may yet secure local control, and science may yet devise a means of using the natural enemies more generally. While the introduction of exotic enemies of other insects might seem attractive, they must have the ability to transfer their attentions to a new host. This very ability may be their main drawback as effective tsetse enemies, in view of reduced efficiency owing to the presence of other possible hosts. Further, they may develop a predilection for those dipterous insects which are already enemies of *Glossina*.

Man is perhaps the greatest friend and enemy of insect pests. Through his own activities he encourages them to acquire their status as serious pests. When that status is recognised, he turns his attention to their destruction or control. When he ceases to encourage them they cease to be pests, except where he has changed their environment to such an extent that they are encouraged by nature. His plan of attack must be to alter their environment so that they cannot flourish.

SOME POINTS FOR CONSIDERATION.

In reviewing some of our data, we can pick out several little-opposed conclusions bearing on the possibilities following the reduction of game, but it must be borne in mind that they represent a collection of statements concerning different flies, different trypanosomes, and different conditions. Nevertheless, they are given for what they are worth, so that readers may attempt to draw their own conclusions from them. The writer has no wish to emphasise the points unduly.

One mating of tsetse-flies is sufficient for the production of four larvæ.

Tsetse-flies may feed on wild animals other than game. (With *G. pallidipes* in Zululand the meagre evidence available is to the contrary.)

Tsetse-flies may be present in numbers where game is apparently absent.

Where game has been made scarce, tsetse-flies have become greatly reduced in numbers in the locality.

The activities of tsetse-flies are almost entirely confined to daylight hours.

Tsetse-flies are said to wait beside game paths for hosts.
Breeding-places of tsetse-flies are near game paths.
Oppression reduces the number of game animals and tends to make them wary or nocturnal.
Where there is less game there are fewer or less-used game paths.
T. vivax infection in tsetse-flies dies out when the flies that carry them are starved.
It has been suggested that semi-starvation of tsetse-flies may cause the females to cease breeding, or to abort.
The rate of reproduction of tsetse-flies is low.

"The tsetse-fly is obviously very delicately poised in the balance of nature. . ."

FURTHER RESEARCH.

It will be noticed that much of our information regarding tsetse-flies is controversial. This state of affairs has probably been brought about by the study of different species of tsetse or of the same species in different environments. For our immediate purpose in South Africa it would be valuable to know how the previous section would read were Zululand conditions, flies, and trypanosomes to be embodied therein. Until further research is carried out this cannot be done.

The services of chemists in association with entomologists, veterinarians, and protozoologists have to some extent been neglected in tsetse-fly study. An interesting discovery would be that of a chemical or an organism which could be safely and conveniently applied to and retained by animals, externally or internally, and that would bring about the birth of premature larvæ or the pupation of larvæ *in utero*, or otherwise upset normal reproductive functions. Although the writer is far from being optimistic that such a discovery will be made, nevertheless the phenomenon of abortion, especially, is common in the laboratory and insectary.

Before conducting a campaign of any sort, it is wise to know where the enemy lies, where he is likely to go when attacked, and what his methods are. We have at least a little knowledge of the methods or habits of the tsetse-fly in Zululand, and some knowledge of its whereabouts. But we could not mark on a map the definite distribution of the fly.

SEVENTY YEARS AGO.

(From the Chemical News, Jan. 21, 1860.)

THE ATOMIC THEORY.

The atomic theory has already been the subject of some dispute : still I venture to draw attention to it, because it appears to me to be to some extent inconsistent with *itself*; and it can scarcely be desirable that a false theory should hold ground, even though it may serve to explain some phenomena easily, because it might have a tendency to warp our ideas of the nature of matter, and it must be allowed that an easy explanation is dearly bought, if it be *at the expense of truth*.

In the atomic theory it is assumed that matter is not indefinitely divisible, but that after a certain point, further division becomes impossible, not for want of means to carry the division to a greater extent, but because the particles into which the matter is divided are units in themselves, and by their nature cannot be divided; they are, in fact, atoms. Each of these atoms, it will be allowed, has a certain length, breadth, and thickness, and occupies a certain space. Since it occupies space, it must have different parts; for if we imagine the extremity of a plane of infinite tenuity to be placed so that it may be opposite to the centre of the atom and also touch it, there would clearly be a portion of the atom projecting on each side of the plane. If it did not do so, it would be a *point*, which has no magnitude, and therefore would no longer be an atom. It is evident from this, that an atom has different parts; and one would imagine that these parts must be kept together by some law. According to the theory, the parts of the atom keep together because they are *one*, or, in other words, because they do. This is at best an unphilosophical method of explaining the constitution of an atom. Perhaps according to the theory, an atom has no constitution at all. In that case, it is difficult to imagine it to have any existence at all. If it is admitted that the different parts of the atom are held together by some law, it then ceases to be an atom. We have only on overcome this law, and the atom will separate.

Again; according to the theory, all forces such at attraction, etc., and motion, must exist *exterior* to the atom, and have nothing to do with its internal constitution; for it is inconsistent with the theory to imagine it [illegible] constitution. This

being the case, what end is answered by the atom being there at all, for the material universe might go on just as well without it as with it. In short, why not adopt Faraday's theory of the existence of matter, or Berkeley's, of the non-existence of matter; for this last theory simply goes a step farther than Faraday's. The atomic theory viewed as a stepping-stone to these would seem to be philosophical. Taken alone it is difficult to understand in what respect it renders the explanation of chemical combination, etc., more simple than before. It appears to me rather to *hide* the difficulty than to explain it, for in what respect is it better to say one *atom* of H combines with one *atom* of O, and they together make one atom of HO; or to say one *equivalent* of H combines with one *equivalent* of HO? When we express this reaction according to the atomic theory, we have done nothing more than remove the difficulty as to the individual atoms, which can scarcely be considered as explaining the phenomenon.

WATER SOFTENING FOR STEAM BOILERS.

AN IMPORTANT BRITISH CONTRACT FOR HIGH MAGNESIUM CONTENT WATER.

By a Well-known Engineer.

In various countries of the world much more attention is being given to the use of water softening for steam boilers, including locomotives, and notable in this connection is a contract that the south African Railways and Harbour Board have placed with the Paterson Engineering Co., Ltd., of London. This consists of ten water softening plants on the lime and soda ash principle, which are to be erected at different stations between De Aar and Matjesfontein on the main line running over the Karroo Plateau, from Capetown to Pretoria.

The plateau is an area with nortoriously bad water, and the locomotive boilers have given much trouble that it has been decided to supply pure softened water only, not exceeding 5° total hardness. Also the ten plants vary in size from 8000 to 16,000 gallons of water per hour capacity, being all of the vertical cylindrical type, and it may be stated the business was secured for Great Britain in the face of severe international competition. The South African Railways and Harbour Board, however, have had mos satisfactory experience with a "Paterson" lime and soda ash plant installed five years ago at their Depot in Pretoria, with a capacity of 10,000 gallons per hour, while another plant on the same line has been dispatched at Naaupoort.

As usual there will be included the firm's bye-pass "Osilameter" feed gear for the lime and soda ash reagents, which adds these chemicals automatically in proportion to the varying flow of the water, but at the same time when the hardness varies, allows the supply of the reagent to be adjusted instantly while the plant is in operation.

The greater part of the hard water, about 80 per cent. of the total flows direct into the top of the vertical cylinder, operating a water wheel, driving the whole arrangement, while the remaining 20 per cent. of the hard water is bye-passed and actuates a small tipper vessel or Osilameter, which discharges at short intervals a small measured amount of the reagent, the speed being altered merely by turning a valve. The main point of course in connection with any lime and soda ash plant is the design of the reagent feed gear, not only accuracy in flow and adjustment, but also freedom from breakdown and liability to sticking.

Highly interesting also in connection with this contract is that each of the plants is to have no less than 6 hours' settling capacity, due to the high magnesium content of the water. In any case, even with ordinary water, no lime and soda ash plant should be installed with less than 3 hours' settling, and if any appreciable amount of magnesium is present it is best to increase this to 4 hours, while in bad cases this period also has to be exceeded, since of course magnesium hydrate is precipitated which only separates slowly, quite different to calcium carbonate.

MARKET FOR DISINFECTANTS INSECTICIDES AND ANIMAL DRESSINGS IN CHINA.

A confidential report on the market for disinfectants, insecticides and animal dressings in China has been prepared by the Department of Overseas Trade from information furnished by the Acting Commercial Counsellor at Shanghai and issued to firms whose names are entered on its Special Register.

Firms desirous of receiving a copy of this report together with particulars of the Special Register service of information and form of application for registration should communicate with the department of Overseas Trade, 35, Old Queen Street, London, S.W.1. Reference B.X. 6838 should be quoted.

AGRICULTURAL AND INDUSTRIAL PROGRESS IN CANADA.

After ten years of striking development one of the most momentous transformations in the history of world economics has taken place in Canada. The Golden Prairie Land has won eminence as an industrial country during the last decade. In the continued expansion of the singular diversity of Canadian manufacturing enterprise it gives important openings to British men who are prepared to avail themselves of the opportunity offered.

In pursuit of this announcement some fundamental considerations are emphasized. One is that British manufacturers should take a larger part in big exhibitions held in Toronto. The second essential is the investment of much more British capital in Canada. Opportunity lies on every side for the man who is prepared to put up a factory and employ Canadian labour. A third point that British observers in the Dominions are never tired of explaining the need for branch factories and offices of British manufacturing firms.

The United States true to its tradition of being a great business country, is a great help and not a hinderance to the country across the frontier. There are several instances of Canadian and American manufacturers working together with mergers on an increasing scale.

The secret of American success in Canadian industry, was the early realization that the only way to participate in the Dominion's market was to go there and build branch factories. Manufacturers from the south are following this principle boldly, and have begun a movement of expansion across the border that is unremitting.

The Dominion which has made remarkable progress during the past fifteen years as an industrial producer, and will probably make notable strides during the next two decades. It is worth while mentioning that the Dominion is taking steps to retain for its own manufacturers a large share of its business, and is extending export markets for its manufactured goods.

A number of United Kingdom exporters are likely to lose the business they are now enjoying or fail to establish satisfactory relations unless they apply methods to suit the changing conditions. The manner in which many United Kingdom firms are handling the Canadian market at the present moment can only bring disappointment, losses and eventual withdrawal. A new understanding and more enterprise are needed. The Dominion has ceased to be primarily an agricultural country and has become first an industrial producer. Our firms at home, therefore, are not dealing with a market which has issued a clarion call for manufactured goods of all kinds. On the contrary, there is a demand on the part of the Canadian manufacturers and others that the imports of manufactured goods be reduced.

It is however noticeable that British industrialists and investors are showing increasing interest in Canadian opportunities. True, the volume of American investment largely exceeds that of the United Kingdom, but the present and immediate future are of special significance in the advantages which they hold for participation by British capital in Canada's onward march to her high economic destiny.

CANADA'S MINERAL PRODUCTIONS.

Zinc.

Canada's zinc production includes zinc made at Trail, B.C., and the recoverable zinc in ores and concentrates exported; ores treated at the Trail plant of the Consolidated Mining and Smelting Company are chiefly those from the Sullivan mine, but important tonnages are also received from other mines in the east and west Kootenay districts. Zinc ores and concentrates were exported from the Tetreault silver-lead-zinc mine in Quebec, and a considerable amount of zinc was also reported as contained in zinc concentrates shipped from the Errington mine in the Sudbury district, Ontario, to European smelters. During the year intensive development work was done on zinc ore bodies in Cape Breton, northwestern Quebec, and in Manitoba.

Chromite.

The recent developments in chromium plating have immensely enhanced the demand for chromite, and last year 126 tons of chromite were sent out from properties in the Clinton mining division in British Columbia for experimental purposes. The consignment was made by the Consolidated Mining and Smelting Company, Ltd.

Lead.

The Trail smelter, treating the lead ores from the Sullivan mine at Kimberley, B.C., and the purchased silver-lead ores from the Kootenay district, was the greatest contributor to Canada's production of lead. The bal-

ance of Canadian production consisted of the pig lead cade at Galetta, Ontario, together with the recoverable lead in lead ores and concentrates exported from the Mayo district of the Yukon, and the Tetreault mine in Quebec.

The Treadwell-Yukon Company continued active development of the Errington mine in the Sidbury district and shipped an increased amount of concentrates. An extensive development and construction programme was continued at both the Flin Flon and Sherritt Gordon mines in Manitoba.

MANGANESE.

Bog Manganese was produced in New Brunswick during 1929, the output amounting to 301 tons valued at $1,830. Imports of manganese oxide amounted to 99,139 tons valued at $990,608, as against 106,443 tons worth $1,058,821 in 1928.

FROM MADAME CURIE'S LABORATORY, PARIS.

Old readers of the *Chemical News* will remember that Madame Curie contributed a series of articles on Radium which attracted world-wide attention at the time. As will be noticed by an advertisement in our present issue, an old *Chemical News* reader has for sale 2 milligrammes of radium which came from Madame Curie's Laboratory, and which has been certified by the N.P.L.

CHEMICAL CORPORATION'S IMPROVED POSITION.

The committee of shareholders appointed in April last to investigate the affairs of the Chemical and Metallurgical Corporation have now issued an interim statement on the present position. They state that all questions relating to the previous management of the affairs of the corporation are *sub judice* and cannot therefore be reported on at this stage. Their investigation enables them to say :—(1) That the corporation has at its command sufficient funds to carry on its business according to present plans; (2) that the reorganisation of the works (now practically complete) has resulted in substantial economies in production costs and overhead expenses; (3) that during the month of July the plant was working at slightly under 50 per cent. capacity, and a special examination by the company's auditors of the accounts for that month showed a small surplus after charging all outgoings (including an allowance for depreciation).

Proceedings and Notices of Societies

THE ROYAL SOCIETY.

Thursday, November 6.

The following papers were read :—

The Slow Combustion of Ethane. By W. A. BONE, F.R.S., AND S. G. HILL.

The paper describes experiments upon the slow interaction of $2C_2H_6+O_2$, $C_2H_6+O_2$, $C_2H_6+2O_2$, etc., mixtures at 290 to 320° C. and pressures between 420 and 780 mm. in which it has been shown that (i) it involves essentially " chain reactions," preceded by well-marked " induction periods " during which the ethane and oxygen do not combine but merely " get ready "; (ii) addition of small amounts of third bodies, such as moisture, ethyl alcohol, aldehydes, iodine, nitrogen peroxide, etc., materially shorten or may even obliterate the induction period; (iii) the subsequent oxidation then proceeds in a manner consistent with the " hydroxylation " theory, at a rate dependent chiefly upon the ethane concentration, it being higher for $2C_2H_6+O_2$ than for $C_2H_6+O_2$ and very much more so for $C_2H_6+2O_2$ mixtures under like conditions; (iv) " peroxidation " is not in evidence during the " induction period " although inconsiderable amounts of a " peroxide " are concomitant with the acetaldehyde-stage of the combustion, and (v) the primary oxidation product would seem rather to be either C_2H_6O or some even less oxygenated ethane.

An Experimental Determination of the Intensity of Friction on the Surface of an Aerofoil. By A. FAGE AND W. H. FALKNER. Communicated by L. Bairstow, F.R.S.

The intensity of friction over the surface of a large symmetrical aerofoil of the Joukowski type (chord 39.7 inches) has been determined from measurements of velocity taken very near the surface with small surface tubes of the Stanton type. These tubes allowed measurements of velocity to be taken at distances of 0.002 to 0.003 inch from the surface.

The velocity gradients at the surface $(\delta V/\delta z)_{z=0}$ were determined from these velocity measurements, and the intensities of the surface friction (f) from the well-known relation $f=\mu(\delta V/\delta z)_{z=0}$.

The results obtained showed that on each surface the frictional intensity had a maximum value at a short distance from the nose, and a second and larger maximum value just beyond the first. The first maxi-

mum value was associated with laminar flow, and the second with turbulent flow in the boundary layer.

Measurements of velocity in the boundary layer were also made with small exploring tubes, and these measurements were found to be compatible with those made nearer the surface with the surface tubes.

Evidence on the general accuracy of the values of the frictional intensity was obtained from a comparison of the fractional drag of the aerofoil estimated from them with values obtained by two other methods.

The Mobility of Ions in Pure Gas. By A. M. TYNDALL AND C. F. POWELL. Communicated by A. P. Chattock, F.R.S.

Measurements of the mobility of positive ions in nitrogen and helium have been made in an all metal-glass apparatus which can be subjected to rigorous heat treatment. The method used has a high resolving power for ions of different mobility and was tested by preliminary experiments in dry air. In experiments with nitrogen the negative carriers were in every case electrons, but in spite of this the results with positive ions were variable. The results disclosed the very great importance of small traces of impurity on the mobility of the positive ions. The effect was even more striking in experiments with helium. Values of 17 and 14 were obtained instead of the value 5 obtained originally by Franck. Slight contamination of the gas on standing transformed the ions into a mixture of widely differing mobilities, a group of mean mobility 10 predominating. The removal of liquid air from a trap, inserted to prevent the access of mercury vapour to the gas produced a further marked effect.

The results are in accordance with the view that a positive ion can capture an electron from a neutral molecule of lower ionisation potential with a consequent change in the nature of the ion.

In order to obtain the values for the mobility of positive ions moving through their own gas, at pressures of 100 mms., or more, it will be necessary to reduce the amount of foreign impurity to the order of one part in a million. At present no significance can be attached to any of the values recorded in the literature.

The following papers were read in title only :—

The Electric and Magnetic State of the Interior of the Earth. By S. CHAPMAN, F.R.S., AND A. T. PRICE.

A detailed examination is made of the currents induced within the earth by the primary outer fields of the daily magnetic variations, and of the storm-time variations of the earth's field during magnetic storms. The induction is supposed to occur within a uniform conducting core of which the upper surface is at a depth of about 250 km. below the earth's surface, and the conductivity is assumed to have the value $3.6.10^{-13}$ already found by Chapman from the daily magnetic variations. It appears that this value is not consistent with the induced field observed during magnetic storms, and evidence is found for a rather rapid rate of downward increase of electrical conductivity in the layer below 250 km.

On the Force Required to Stop a Moving Electrified Sphere. II. By G. F. V. SEARLE, F.R.S.

In the *Proceedings* the author gave in 1907 an expression for the force F required to stop a charged sphere of radius a and charge Q which had been moving with velocity u less than v the velocity of light. The method depended upon the energy W′ and the momentum P′ carried off to infinity by the compound electro-magnetic wave formed when the sphere is stopped at time $t=0$ and is re-started with velocity u at time t. In the present paper F is found by the formula

$$F=\frac{Q}{4\pi a^2}\int E_x dS,$$

where dS is an element of the surface of the sphere and E_x is the component in the direction of u of the electric force at dS due to waves from those elements of the surface which at time t are at a distance vt from dS. It is found that—

$$F=\frac{Q^2}{2Ka^2}\left\{\frac{v}{u}-\frac{v^2-u^2}{2u^2}\log\frac{v+u}{v-u}\right\},$$

from $t=0$ to $t=2a/v$. When $t>2a/v$, $F=0$.

On the Spectroscopy of Auroral Green Line Radiation. By J. C. MCLENNAN, F.R.S., AND H. J. C. IRETON.

Speculations Concerning the α-β- and γ-rays of Ra B, C, C′, I. By R. H. FOWLER, F.R.S.

In extension of Miss Swirles's theoretical work on the internal conversion coefficients of the γ-rays from Ra B, C, C′, D. I have replaced the ideal Hertzian oscillator in the nucleus used in her theory by an actual model nuclear quantum-mechanical system, interacting by Coulomb forces with the electrons of the outer atom, in order to see if

anything has been overlooked in her theory which might explain its discrepancies with the observations of Ellis, and particularly Ellis and Aston. It has been possible to show that there is no likelihood of any serious modification of her calculations in this way so long as the dipole moment of the two nuclear states concerned in the emission of any γ-ray does not vanish.

When, however, this dipole moment vanishes and the nucleus can, practically, speaking, not *radiate* this frequency at all, the more correct interaction integral of the revised theory still does not vanish, but survives, *operating ejections of the K-(etc.)* electron as a β-particle by collision with the nuclear particle, when the K-electron actually enters the nucleus. Interactions of this type seem to give an elegant and satisfying explanation of the queer "γ-ray" from RaC′ of 1.426×10^6 volts, which is associated with some of the strongest lines in the β-ray spectrum but probably has never been detected as a true γ-ray at all.

N.B.—It seems further quite likely that these β-rays arise from transitions between that upper state of the nucleus which gives rise, according to the theory of Gamow and Gurney and Condon, to the long range group of α particles of 9.2 cm. range, and the normal state which produces the 7 cm. α-particles. The relative frequencies of emission of these β-rays and the 9.2 cm. α-particles are in excellent agreement with this view, and the energy differences of the states, *and of the α-particles agree to about* ½ per cent., so far as they can be estimated at present.

THE PHYSICAL SOCIETY.

At the meeting on Friday, November 7, 1930, at the Imperial College of Science, South Kensington, S.W.7., the following papers were read:—

The Absorption and Dissociative or Ionising Effect of Monochromatic Radiation in an Atmosphere on a Rotating Earth. By S. Chapman.

The absorption of monochromatic radiation from the sun in an atmosphere in which the density varies exponentially with height is considered; the energy of the radiation, or a definite fraction of it, is supposed to dissociate or ionise the air, and the dissociation products are supposed to recombine with one another only, and not to diffuse away from the element in which they were formed. The resulting distribution of density of the dissociation products is determined, a constant recombination-coefficient being assumed, while account is taken of the variation in rate of dissociation due to the earth's rotation. The results are illustrated by numerous diagrams showing the density of the dissociation products as a function of height, time, latitude and season.

Turbulent Flow Through Tubes. By W. N. Bond, M.A., D.Sc., F.Inst.P., Lecturer in Physics in the University of Reading.

The flow of fluid through long straight tubes of circular section was experimented on, at speeds in the neighbourhood of the lower critical velocity, in an attempt to detect any trace of periodicity in the turbulent motion. *The experimental methods* included (*a*) an aural method; (*b*) photography of the motion of a deflected vane; and (*c*) injection of colour-streams about half-way along the tube. Intermittent turbulence was investigated at speeds near the critical speed, and measurements of the critical speed were made. It was shown that the velocity parallel to the tube-axis is sometimes almost uniform momentarily over the transverse section.

No trace was found of a simple frequency, but evidence was obtained of a predominant wave-length in the turbulent motion at the critical speed. Both these observations seem to agree with the approximate theory given by Heisenberg for flow between a pair of parallel planes.

The Spectrum of Trebly Ionised Cerium (Ce IV). By J. S. Badami, Imperial College of Science and Technology.

The spectrum of the condensed spark of cerium has been investigated in the ultraviolet, and double combinations in Ce IV have been found besides those given by Gibbs and White. The $6^2P - 6^2D$ combination of La III has also been identified. Term values and ionisation potentials of La III and Ce IV are calculated.

The Photographic Effects of Gamma-Rays. By J. S. Rogers, B.A., M.Sc., F.Inst.P., Senior Lecturer in Natural Philosophy, University of Melbourne.

The photographic action of γ-rays from radium and radon in euqilibrium with their short-lived products has been investigated, the rays being filtered with lead screens of thickness 0, 0.19, 1.42, 2.61 and 4.03 cm. The variations of photographic density both with time and with intensity have been examined. The shape of the characteristic (*C*) curves ($D - \log I$) have been found to be independent of the filtering, and the same holds for the Hurter-Driffield (HD) curves ($D - \log t$), except when no lead filter is used. The value of p in the Schwarzschild

relation, $D=f\ (It^p)$, has been found to be unity for all the lead filters. The absorption-coefficient of lead for γ-rays from the sources used has been found to be 0.533 cm.$^{-1}$ for thicknesses of lead from 1 to 7 cm.

SOCIETY OF GLASS TECHNOLOGY.

At the meeting held in Sheffield on 15th October, 1930, two papers were presented :

The Effect of Remelting on the Properties of Glass. By PROFESSOR W. E. S. TURNER.

In his opening remarks, Professor Turner referred to the stimulating discussions on the use of cullet which had taken place at earlier meetings of the Society. Investigations into the subject had been proceeding at Sheffield for some years, glass being melted and re-melted many times, the effect upon the working properties being reported by an experienced glass worker drawing rod. It was concluded from these practical tests that as the proportion of cullet to the batch was increased and also when cullet itself was repeatedly melted, progressive changes took place in the glass properties. This view was confirmed by others engaged in commercial glass-making, but there was no means of direct corroboration in accurate laboratory work.

About a year ago, the results of a series of laboratory experiments were reported to the Society, glass having been melted and remelted many times, samples from each being investigated carefully. Melting was carried out in fireclay and sillimanite pots in one series of experiments, while in another the melting was done in platinum.

Any small changes in the properties of the glass melted in fireclay or sillimanite were masked by the absorption into the glass of aluminous material from the pots.

The glasses melted in platinum were free from such contamination by corrosion, hence the chemical composition and certain physical constants were measured after each successive melting, the glass being homogeneous.

Measurements of annealing temperatures, density, and coefficient of expansion revealed no change as long as the glass was homogeneous, and as long as its chemical composition remained constant.

In order to obtain further corroboration on this point, determinations of the electrical conductivity of the glasses were put in hand, and the X-ray structures had been examined. The X-ray examinations had been conducted by Messrs. J. T. Randall and sion of Mr. C. C. Paterson, at the Research Laboratories of the General Electric Co., Wembley. These experimenters had prepared X-ray diagrams of the extreme members of the series of glasses, and an intermediate member, but not the slightest difference was found.

The determination of the electrical conductivities of the glasses were not yet completed.

All the evidence gained from the investigations into the various properties of the glasses, therefore, showed that, if the heating were such that the chemical composition of the glass remained constant, then the physical properties exhibit no change. This conclusion did not support the general observations of the glassworker, hence the changes in working properties previously reported were probably due to non-homogeneity in the glass.

The Thermal Endurance of Glass: An Examination of the Method of W. M. Hampton and C. E. Gould. By W. J. A. WARREN, B.Sc.

Before Mr. Warren read his paper, Dr. Hampton briefly summarised the work done by himself and Mr. Gould. This had been published already in the Society's *Journal* (1930, xiv, 188).

Part I of the new paper was an examination of the method of Gould and Hampton based on tests on beakers between 1 to 2 mm. in thickness. The correction of the observed thermal endurance according to the formula proposed by Gould and Hampton, although slightly excessive, was better than making no correction for thickness provided all cases where the fracture had not penetrated the concave portion of the bottom were first rejected. No effect was observed due to slightly uneven distribution of the glass in the beaker or to shielding the beaker from draughts during the tests. In the range of thickness proposed for the tests a more accurate and simpler formula was proposed.

Part II dealt with the relation between theory and the results obtained. The distribution of the individual values of thermal endurance obtained in the tests did not give a typical error curve. Reasons were given for concentrating attention on the main group of values and various formulæ were tried.

The thermal endurance of beakers of sheet glass composition was still gradually decreasing after they had been made two months and was further reduced 9 per cent

Forthcoming Events.

ROYAL SOCIETY OF ARTS.

Wednesday, November 26, at 8 p.m.—" The Chemical Constitution of Coal." By W. A. Bone, D.Sc., Ph.D., F.R.S.

CANTOR LECTURES.

Monday Evenings, at 8 p.m.—" Modern Domestic Scientific Appliances." By Prof. C. R. Darling, F.I.C., F.Inst.P. Three lectures, November 24, December 1 and 8.

Lecture I.—Lighting of Rooms, Modern Practice in Illumination by Means of Electricity and Gas. Recent forms of Lamps and Burners. Distribution of Light, Incandescent Oil Lamps.

Motor - driven appliances. Vacuum cleaners. Washing Machines. Hair Dryers. Ventilating Fans. Sewing Machines. Miscellaneous Devices.

Lecture II.—Heating of Rooms. Direct heating of solid fuels : recent improvements. Grates and stoves for burning smokeless fuels. Gas fires and radiators. Electric radiators and tube heaters. Panel heating. Pipeless heating by warmed air. Comparison of efficiencies and costs of the different methods. Hot water supply. Boilers using solid fuels, gas and oil. Boilers heated by electricity. Use of lagging. Control of heat supply.

Lecture III.—Modern Cooking Appliances. Newest forms of coal-fired ranges. Stoves using anthracite and coke. Gas stoves. Electrical cooking apparatus. Modern oil stoves. Thermostatic control of pens. Steam cookers. Miscellaneous devices. Water softeners. Small utensils. Refrigerators, compression and absorption types. Various kinds using electricity or gas. Use of solid carbon dioxide. (The lectures will be illustrated by experiments.)

THE OPTICAL SOCIETY.

Thursday November 13, at 7.30 p.m., at the Imperial College of Science and Technology, Imperial Institute Road, South Kensington, S.W.7. The following demonstrations will be given :—

(1) " Photo-electric Cell Applications, illustrating some important properties which are made use of in optical work." By the Research Staff of the General Electric Co., Ltd.

(2) " The Use of the Spectograph in Metallurgical Analysis." Spectograms of specimens will be taken and developed on the lecture table and the spectra projected ... A.R.C.S., B.Sc., D.I.C., of the Non-Ferrous Metals Research Association.

(3) " A New Spectrophotometer." By H. Buckley and F. J. C. Brookes, of the Photometry Department, National Physical Laboratory.

ROYAL INSTITUTION.

21, Albemarle Street, W.1.

Saturday, November 15, at 3 p.m.—" Some Recent Archaeological Work in Italy." By A. Hamilton Smith, C.B., M.A., F.B.A.

Tuesdays, November 18, and 25, at 5.15 p.m.—" Two Old Friends of the Royal Institution. (1) William Spottiswoode. (2) Warren De la Rue." By Sir William Bragg, K.B.E., M.A., F.R.S., M.R.I.

Thursdays, November 20 and 27, at 5.15 p.m.—" Colour Vision." By L. C. Martin, D.Sc., A.R.C.S.

THE INSTITUTE OF METALS.

LONDON LOCAL SECTION.

Thursday, November 20, at 7.30 p.m., at the Royal School of Mines, South Kensington, S.W.1.—" Some Non-Ferrous Metals in the Chemical Engineering." By Richard Seligman, Ph.Nat.D.

SHEFFIELD LOCAL SECTION.

Friday, November 14, at 7.30 p.m., in the Non-Ferrous Section of the Applied Science Department of the University, St. George's Square — " Unsoundness in Metals." By H. Hyman, Ph.D.

ROYAL INSTITUTE OF PUBLIC HEALTH.

Wednesday, November 19, at 4 p.m.—" The Prevention of Venereal Disease." By Arthur Massey, M.D., D.P.H.

MANCHESTER CHEMICAL SOCIETIES.

INSTITUTE OF RUBBER INDUSTRY.

Thursday, November 20, at 7 p.m., at the Manchester, Ltd., Royal Exchange.—" The Evaluation of Raw Rubber." By G. Marin, B.Sc., A.I.C., F.I.R.I.

SOCIETY OF DYERS AND COLOURISTS.

Friday, November 21, at 7 p.m., at the Lit. and Phil. Society, George Street. —" Some Remarks on the Treatment of Aniline Black subsequent to Ageing." By Dr. J. L. Hankey.

OIL AND COLOUR CHEMISTS' ASSOCIATION.

Manchester Section.

The Section will hold its Sixth Annual Dinner and Dance at the Manchester, Ltd., Royal Exchange, Manchester, on Saturday, ...

New Patents.

These particulars of New Patents of interest to Readers have been selected from the *Official Journal of Patents*, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

31,440.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of halogen-alkylenated 1-aryl-5-pyrazolone derivatives. October 20.

31,564.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of halogenated aminoaryl - thiazole compounds. October 21.

31,439.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of anhydrides of aliphatic halogen acids. October 20.

Specifications Published.

336,688.—Du Pont de Nemours & Co., E. I. —Process for the manufacture of concentrated nitric acid.

336,677.—Elektrochemische Ges., and Grohmann, H. — *Manufacture of* calcium cyanamide.

316,950.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of derivatives of naphthalzarin.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

EBONAL.

516,045.—All goods in class 1 which includes chemical substances used in manufactures, photography, or philosophical research and anti-corrosives. — Reckitt and Sons., Ltd., Kingston Starch Works, Dansom Lane, Hull. October 29.

VI-RANIUM.

514,633.—All goods in class 2 which includes chemical substances used for agricultural, horticultural, veterinary and sanitary purposes.—Albert Henry Brain, Visol Laboratories and Experimental Poultry Farm, Tanhouse Lane, Great Barr, near Birmingham. October 29.

GRAMMAR OF LOGIC.

100 Questions and Answers on The Grammar of Logic or *How to Reason Correctly*. By J. E. Roscoe, M.A., Oxon.

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BRICK KILN PATENT FOR DISPOSAL.

Mr. V. Lastovicka, of the Japan and China Trading Co., 56, Rasin Embankment, Prague, Czechoslovakia, is open to receive offers for the exploitation of his patented "Tunnel" Brick Kiln Construction in Great Britain and Dominions and Colonies.

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THE COLLINSIC OF CRESTMORITE.

By HAWKSWORTH COLLINS, B.A. (Camb.).

It was mentioned a few months ago that in order to make more progress in the matter of the collinsics it was necessary to omit about fifty minerals, which did not concern any other chemical elements than those already considered. But the conclusion has now been reached that this decision was a mistake, because scientists generally appear to think that the definite results obtained in the first 183 collinsics are due in some way to the jugglery of figures. It was also a mistake to commence rushing into the huge matter concerning organic substances, as was done in the last paper in June of this year. So the object at present is to demonstrate as fully as possible by means of the fifty omitted minerals that the exact relative volume of each atom in every mineral has undoubtedly been found, and that each R.V. has a corresponding optical refractivity, and that each collinsic is an exact discovery which gives scientists an enormous amount of fresh knowledge concerning the chemical elements.

There is a separate problem to be solved for each mineral. The data are provided by other scientists and consist of the specific gravity of the substance at 15° C., and its normal refractive index for a ray of sodium light, together with the recognised atomic weights of the elements.

The problem to be solved for each mineral consists in the discovery of the correct interpretation of the data, which of course must correspond exactly with the similar interpretations for preceding collinsics.

Each new mineral will therefore be considered in full separately for the present, in order that scientists may have an opportunity of seeing easily that there is no jugglery of figures involved in the matter.

TABLE XXXII.

(184) The Collinsic of Crestmorite. $4CaSiO_3, 7H_2O$

Theor. S.G. 2.229 Obs. S.G. 2.22W

$$Ca_4 + Si_4 + O_4 + O_8 + 7H_2O$$

$$\mathbf{158.60 = 0.5991(13.25_4 + 18.91_4 + 4.45_4 + 2.51_8 + 14.03_7)}$$

Theor. R.I. 1.5991 Obs. R.I. N_m1.603 W N_p1.593 W

$$\mathbf{158.604 = 13.25_4 + 10.461_4 + 1.747_4 + 1.346_8 + 6.572_7}$$

EXPLANATION OF TABLE XXXII.

The first line gives the specific gravity, theoretical and observed. The second line gives the chemical formula arranged as required. The third gives (between the brackets) the *relative volume of each atom*, together with the product obtained by multiplying the total volume by $\mu - 1$, where μ is the normal refractive index of the mineral. The fourth gives the theoretical and observed refractive indices. The fifth gives the optical refractivity of each element and also their sum, which in all the 184 collinsics corresponds to four figures with the product of the third line directly above it. The O.R. of each atom is placed directly under its R.V. The thick type gives the discovery, whilst the ordinary type gives the experimental data.

TABLE XXXIII.

The Voloptics of those chemical elements which constitute the molecule of the mineral Crestmorite.

Element	R.V.	O.R.	Number of times this voloptic has occurred in the first 184 collinsics
Ca	14.54	10.52	79
Ca	13.25	13.25	25
Si	18.91	10.461	47
Si	17.61	9.625	59
Si	13.83	9.78	54
Si	13.02	11.53	66
O	7.53	1.654	258
O	4.45	1.747	222
O	2.51	1.346	1362
H	5.76	2.613	810

Table XXXIII is intended to be read as follows :— When an atom of calcium in a mineral has the relative volume 14.54, its optical refractivity is 10.52; (these two values together are called a voloptic) and this voloptic has now occurred 79 times in the first 184 collinsics; etc.

The publication of the collinsics was commenced in the *Chemical News* on May 18, 1928.

There is no hypothesis of any kind involved in the matter. Every figure in a collinsic corresponds within 1 per cent. either with experimental data or with figures in other minerals. The former are called Colls, and there are always three of them in each collinsic. The colls in this mineral are as follow :—

METHOD OF DISCOVERY OF THE COLLINSIC OF CRESTMORITE.

If the molecular weight (590) be divided by 2.22, the result is about 265. When 265 is multiplied by 0.6 ($\mu - 1$) the product is 159. It is therefore settled by the data provided that the total relative volume of the molecule must be about 265 and that the total optical refractivities of the elements must be about 159.

Since the O.R.'s of the three forms of oxygen do not differ greatly, and since one of them (1.346) is far more common than the others, the first approximation to the truth will start by taking all twelve oxygen atoms to have the volume 2.51 and O.R. 1.346.

R.V.	O.R.
2.51	1.346
12	12
30.12	16.152

Crystallised water always has volume 14.03 ($= 2 \times 5.76 + 2.51$) and O.R. 6.572 ($= 2 \times 2.613 + 1.346$).

Add these to the last results obtaining :—

30.12	16.152
$98.21 = 7 \times 14.03$	$46.004 = 7 \times 6.572$
128.33	62.156

Subtracting 62.156 from 159, 96.844 is obtained. Dividing this by 4, the result is 24.211.

This must be about the sum of the O.R.'s of Ca and Si; not more but rather less; because there may be some of the higher O.R.'s of oxygen present. The sum of 13.25 (Ca) and 10.461 (Si) is 23.711. These are the only values possible as any others would be too low. And since they are now fixed, so are the relative volumes. From Table XXXIII these are 13.25 and 18.91. Add them to the last results obtaining :—

R.V.	O.R.
128.33	62.156
$53.00 = 4 \times 13.25$	$53.00 = 4 \times 13.25$
$75.64 = 4 \times 18.91$	$41.844 = 4 \times 10.461$
256.97	157.000

Theor. S.G. 2.229
Theor. R.I. 1.5991
Total theor. O.R. 158.60
obtained by the product
of total R.V. by $\mu - 1$

Obs. S.G. 2.22
Obs. R.I. N_m1.603 N_p1.503
Total theor. O.R. 158.604
obtained in an entirely differ-
ent manner from the results of

If four oxygen atoms have each R.V. 4.45 and O.R. 1.747 the totals become

R.V.
256.97
7.76 = 4(4.45 - 2.51)
———
264.73

O.R.
157.000
1.604 = 4(1.747 - 1.346)
———
158.604

These are the figures given in Table XXXII.

There is no ambiguity, no guesswork, and no jugglery anywhere; and there is no other solution of the problem.

If the product of the R.V. and $\mu - 1$ had been a little greater, say, 161 instead of about 159, it would have been impossible to find a solution. So the fact that the solution of the problem is only just obtainable by employing the voloptics already demonstrated gives the 184th illustration of the certainty of the matter.

By considering each one of the preceding 183 collinsics in the same way it is possible for anyone to discover for himself that the truth has been obtained.

The discoveries that have been made are :
(1) The Relative Volumes of the Elements,
(2) The Optical Refractivity of each element,
(3) That the Gladstone-Dale formula is correct, and not the Lorentz.

The discovery to which the Collinsics lead is :—

The Constitution and Structure of the Chemical Elements.

THE STRUCTURE OF THE ELEMENTS AS FAR AS THIS COLLINSIC IS CONCERNED.

The atomic weight 40 of Ca splits up into 39(K) and 1(H).

The R.V. 13.25 also splits up into 7.49(K) and 5.76(H).

The volume 7.49 for potassium when forming part of another element was found several years before the collinsics were discovered, and published in the *Chemical News*, 1925, CXXXI, 145. The same number, 7.49, has appeared as the O.R. of potassium every time this element has occurred in the 184, *i.e.* 13 times.

13.25 has appeared 25 times as the O.R. of Ca in addition to the 25 times it has occurred as the R.V.

The O.R. 13.25 also splits up into 7.49(K) and 5.76(H).

The volume 5.76 for hydrogen has occurred 810 times in the 184 collinsics.

It follows from this that
(*a*) Potassium both as an element of R.V. 22.29 and also as a part of an element of R.V. 7.49 has the same O.R. 7.49.
(*b*) Calcium of R.V. 13.25 has O.R. 13.25.
(*c*) Hydrogen, as part of an element having R.V. 5.76, has also its O.R. 5.76.

Similar facts to these will be brought to notice as they occur in later collinsics.

The certainty of the fact that oxygen has three volumes was demonstrated frequently in the *Chemical News* in the years 1924-1928 by means of heat of formation.

ABBREVIATIONS.

W = Winchell.
N_m = Mean index of refraction.
N_p = Least index of refraction.

The mean index of refraction is the one that is involved in the collinsics. The least or greatest is only given when the theory does not quite agree with the experimental mean value.

ANALYSIS OF THE 184 COLLINSICS.

It seems to be necessary to point out again and again until the fact is generally recognised that the voloptics, some of which are given in Table XXXIII, are invariable in all these 184 collinsics, and therefore must be exactly correct, especially since they are obtained rom twice as many experimental determinations; *i.e.*, from 184 observed S.G.'s and 184 observed R.I.'s. Or in other words it may be said that the key to 184 puzzles has been found.

But in this collinsic of crestmorite there are three more observations, (A), (B) and (C), which are here made for the first time and which are additional corroborations of the truth of the matter.

(A) It is a general rule that if one atom of Si (*e.g.*) has a relative volume 18.01, then all the Si-atoms present have the same volume and therefore the same O.R. 10.461; and similarly for all atoms except oxygen, which has two general rules of its own. There are only twelve exceptions to the above rule in the first 184 collinsics. The other volume of Ca (14.54) with its O.R. 10.52 cannot come into the collinsic at all nor can any of the other three voloptics of Si.

(B) The first general rule with regard to the oxygen atoms is that—Those of volume 2.51 occur about six times as often as those of volume 7.53, and also about six times as often as those of volume 4.45, *i.e.*, about three times as often as the other two together. (See Table XXXIII).

(C) The second general rule with regard to the oxygen atoms is that—There are not more than two of the higher volumes of oxygen present with each of the non-metallic elements As, P, S, C, Si and B. (*E.g.*, If there are three atoms of phosphorus present in a molecule, then there are not more than six oxygen atoms of vol. 7.53 and 4.45 present). In the case of nitrogen all three oxygen atoms of the group NO_3 always have *the volume 7.53. There are only 21 exceptions* to the first part of the rule in a total of 160 cases.

The important thing to notice with regard to this matter is that—*General Rules cannot appear by accident.*

There are some special cases to be observed with regard to the last rule, and one of them which concerns crestmorite is as follows :— There are 18 minerals which have one higher oxygen atom for each Si-atom present. Crestmorite is the nineteenth.

It is evident, therefore, that the Collinsic of Crestmorite is true without any doubt whatever.

SILICA GEL AS A CATALYST BASE.

An Important Application in the Chemical Industries.

By A Well-Known Engineer.

The successful utilisation of Silica Gel upon an increasingly large commercial scale in many fields, such as dehydration of air and other gases, transportation refrigeration, the refining of light oils and benzol, and solvent recovery, constitutes one of the most striking achievements in chemical technology. It is well known that this active adsorbent can be used over and over again in a continuous cycle of adsorption, revivification, and cooling, and as the material is completely inert from the chemical point of view revivification may be carried out at high temperatures, preferably at about 310° C., although much higher figures, even up to 870° C., do not appreciably change the microporous structure.

To the technical chemist one of the most interesting of the many other applications which have been developed by the Silica Gel Corporation is the use of the material as a catalyst and as a carrier for catalysts. It has been calculated that one gramme of granular Silica Gel, about one-tenth of a cubic inch in volume, has an effective surface area equal to about 5,000 square feet. This great area, coupled with the tough and heat-resisting character, and the comparatively low resistance to the passage of gases combine for example to make Silica Gel the ideal carrier for the platinum catalyst used in the production of sulphuric acid by the contact process. The material has proved in this connection to be able to provide a constant high conversion efficiency in commercial practice at a number of modern acid plants situated in Great Britain, the United States, Belgium, and the Belgian Congo, where the Silica Gel Platinum contact mass has been installed successfully in units whose production capacities range from ten to fifty tons H_2SO_4 per day. In many cases also the units have been overloaded by as much as 40 per cent. of their designed capacity without causing an appreciable diminution in the efficiency of conversion.

The active catalyst, such as platinum, is deposited upon the Silica Gel by a special process, which permits an appreciable reduction in the amount of platinum required for maximum conversion, and this reduces to a very considerable degree not only the first cost but also the operating costs. For example at the works of the Davison Chemical Company in the United States the reduction in the quantity of platinum achieved by the use of Silica Gel on these lnes, represented a saving of about £16,000 in capital cost—approximately 75 per cent. of the amount of platinum which would have been necessary to deposit on an asbestos or magnesium sulphate mass in converters of the same capacity, namely, fifty tons H_2SO_4 in 24 hours.

The Silica Gel contact mass is also in use for converting gases produced by the roasting of arsenical Rio Tinto and other pyrites, as well as brimstone. Highly important is that the presence of chlorine or halogens in the gas does not permanently harm the Silica Gel mass, the efficiency of conversion being merely lowered but with return to normal after purging the mass of such impurities, carried out in situ by passing very hot air at about 430° C. from the preheaters through the mass for 24 hours.

Also water vapour and acid mist have no permanent adverse effect upon Silica Gel, and overheating within the range of temperatures obtained in contact plants does not materially affect the efficiency while the material can be subejcted to intense heat without serious risk of injury and is not attacked by very strong mineral acids, except hydrofluoric.

In view of the facts that the Silica Gel contact mass is not easily " poisoned " and is purged without difficulty, the purification system before the converters can usually be considerably simpler than that normally prescribed for other platinum masses, even when using Vanadium.

It may be remembered that gels of silica have been subjected to laboratory and research investigations for nearly 70 years, and Silica Gel was first prepared by Graham as early as 1860, using the dialysis method, as adopted also by Zsigmondy, Anderson and others, including Patrick. From a commercial point of view, however, dialysis is impracticable, and for this reason the product *remained one of only laboratory* interest until Patrick invented in 1918 a practical method of production.

Dr. Walter Patrick was at that time—and still is—Professor of Chemistry at John Hopkins University, Baltimore, but it was in connection with the chemical warfare services of the U.S. Army that he evolved the process of manufacturing Silica Gel as an adsorbent, which was therefore rendered available for industry, although originally intended for use in gas masks for the adsorption of poisonous gases.

DEPARTMENT OF OVERSEAS TRADE.

The Commercial Secretary, His Majesty's the administration of state Railways and Ports in Angora is inviting tenders for the supply of 40 tons of calcium carbide.

Tenders must be received by the Administration not later than 2.30 p.m. on the 26th November, 1930.

Copies of the specifications were not available in Istanbul when the Commercial Secretary reported the matter, but this notification may be of use to firms who have representatives in Turkey, who are in a position to submit tenders on their behalf. In any case, local representation is essential. The Department of Overseas Trade can provide the names of firms in Turkey who would be willing to act as agents for United Kingdom firms interested in the supply of material of United Kingdom manufacture who are not already represented locally.

THE DYESTUFFS (IMPORT REGULATION) ACT:

Its Influence on the Education of British Chemists and on the Progress of Research in Industry.

The Institute of Chemistry of Great Britain and Ireland, which now includes over 5,750 members, has for its main object the maintenance of a high standard of scientific education and professional training among British Chemists. With this aim in view the council of the Institute regards with grave apprehension the impending lapse of the Dyestuffs (Import Regulation) Act, which has now for ten years encouraged and safeguarded the growth of a virile national industry for the production in this country of synthetic dyes and the requisite intermediates.

In developing this highly technical industry to an extent unprecedented in Great Britain, our industrials have enlisted the services of many British chemical students, thereby offering a new career to the scientifically trained *alumni* of our universities and technical colleges.

Pre-war Conditions.—In 1886, Professor Raphael Meldola, a past-president of the Institute, reviewed the foundation and scientific development of the coal-tar colour industry, and pointed out the national danger arising from the decline of the industry in this country. As the Institute is doing today so Professor Meldola then pleaded for a proper recognition of the importance attaching to the teaching of applied science, and especially of organic chemistry. His warning, however, fell on deaf ears, and his suggestions were disregarded. The British dyestuffs industry remained severely restricted until 1915, when, amid the throes of a world war, British Dyes, Limited, was established with Governmental assistance in order to make a belated attempt, not only to restore the coal-tar colour industry to this country, but to retain it permanently after the war.

The Safeguarding Act.—When hostilities ceased, it began to be revealed that the latter object could only be realised by safeguarding the renascent British industry from foreign competitors and, after some delay, the Dyestuffs (Import Regulation) Act became law on January 15th, 1921. This statute proved to be the turning point in British dyemaking, inasmuch as the very meritorious advances made by our manufacturers under its protection, have gone a long way towards placing our organic chemical industries on an independent footing

But the time has been brief to make good the shortcomings of 70 years, and there are still many problems to be solved before this industry can be regarded as safely established.

The Institute's Action in 1924.—There was a moment of pessimism even in 1924, when it was feared that an agreement might be made between the Interessen Gemeinschaft—the syndicate of German colour manufactnrers—and the British Dyestuffs Corporation. On that occasion, the Council of the Institute intervened to urge the Government of that day not to concur in this proposed arrangement. The Council now feels that the educational aspect of the Dyestuffs Industry is as important to-day as it was six years ago.

Educational Aspects of the Organic Chemical Industries.—It should be realised that the great German colour works of the Interessen Gemeinschaft are not merely commercial undertakings concerned solely with the manufacture of dyes and intermediates, they are industrial universities in the most liberal sense of the term.

They employ a large number of qualified chemists, who work under conditions as congenial to research as are the laboratories of their leading academic institutions. These chemists not only carry out researches on new intermediate coal-tar products and synthetic dyes, but they also investigate the scientific problems arising under the following headings :—

(1) Chemotherapy, bacteriology. The study of therapeutic agents, antiseptics and disinfectants.

(2) Photographic materials such as developers and sensitisers.

(3) Artificial resins of all descriptions.

(4) Synthesis of rubber and rubber substitutes.

(5) Production of fuel and motor spirit.

(6) High pressure chemistry in both inorganic and organic aspects.

(7) Artificial fertilisers of all kinds.

All these important sections of scientific research in applied inorganic and organic chemistry have arisen as side lines during the development of the great German colour industry, which has served as the focus of these activities.

A similar development of research in applied chemistry has been noticeable in Great Britain during the last ten year, and this growth has been undoubtedly fostered by the encouragement given to our chemical manufacturers by the Dyestuffs (Import Regula-

The Dyestuffs Act and the Chemical Profession.—The Chemists who have entered the services of the British colour makers are thereby supplementing their academic training by practical experience of applied organic chemistry, and are thus becoming available for the manifold opportunities now arising for the scientific study and industrial development of the natural resources of the British Empire. It is to the mutual benefit of the constituent nations that this exploitation should be carried out by our chemists. Too often in the past such exploitation has been left to the chemists of other countries. An abundant supply of skilled chemists and technologists, and the maintenance of adequate facilities for instruction and research, are vital to our national prosperity and sesurity.

Conclusions.—1. The Dyestuffs (Import Regulation) Act has had a most beneficial effect in laying the foundation of a national industry for the manufacture of synthetic dyes and intermediates.

2. This important industrial development has had a favourable reaction on the development of our schools of chemistry, and on the growth of other industries dealing with fine chemicals.

3. The number of well-trained chemists in the country is now greater than in any preceding period, and these scientific workers are available for our vital national needs.

4. Since these highly desirable tendencies have risen largely during the short period of the duration of the Act, the council of the Institute respectfully urges that on National and Imperial grounds the Act should remain in operation on similar lines for a further period.

(From the Institute of Chemisty of Great Britain and Ireland).

ROYAL INSTITUTION.

A General Meeting of the Members of the Royal Institution was held recently, Sir Robert Robertson, Treasurer and Vice-President, in the chair. The thanks of the members were returned to Lord Melchett for his gift of a replica of the panel in the entrance door of Imperial Chemical House, representing Faraday lecturing in the Royal Institution. Lord Eustace Percy, Mr. F. D. Edwards, Mr. W. G. Moore and Mr. J. M. Vaizey were elected Members.

GENERAL NOTES

IMPORTANT ADVANCE IN ASTRONOMIC KNOWLEDGE.

Results of Study by Dominion Astrophysical Observatory of Diffuse Gaseous Matter in Stellar System.

The presence of very tenuous gases in the space between the stars, previously indicated and discussed by others, was definitely proved at the Dominion Astrophysical Observatory at Victoria, B.C. about seven years ago. It was then shown that stars of the highest temperature from 30,000 to 50,000 degrees Fahrenheit, of the greatest mass up to about 100 times that of the sun, and of an intrinsic brightness over a thousaud times greater than the sun, were rushing about rapidly in all directions through diffuse gases which were nearly stationary in the stellar system. The gaseous matter which is believed to be of the some *general composition* as the earth, was recognised by the appearance of certain lines in the spectra of these hot stars and was shown to be widely extended throughout the system.

About four years ago Sir Arthur Eddington was led, by the proof at Victoria that the hot stars were in rapid motion through nearly stationary gases, to investigate theoretically the physical properties of this gaseous matter. He was able to show that it must be almost unbelievably tenuous, of thousands of times higher vacuum than an incandescent lamp. Indeed, the whole volume of the earth would contain only about a quarter of a pound of such gases. He showed further that these gases behaved in an almost paradoxical way, that although external space was so cold that a solid body placed in it would fall to about 450 degrees below zero Fahrenheit, the molecules of these diffuse gases were so far apart, about one in every cubic centimetre, that the radiation from all the stars would give speeds to these molecules corresponding to a temperature of about 20,000 degrees. Eddington assumed these rare gases were uniformly distributed in the space between the stars but there was no proof of this uniform distribution nor knowledge of the motions.

While the early observations at Victoria furnished the foundation from which Eddington deduced the physical properties of this gaseous matter, the final observational completion of the whole structure has ust been provided at Victoria where it has been definitely proved that this diffuse gaseous matter is uniformly distributed throughout the stellar system. It has also been shown that this matter is not at rest as previously supposed but partakes in the most beautifully exact way in the orderly and majestic rotation of the stellar system around a very distant centre, the most convincing proof of the similar rotation of the stars *having also been obtained* at Victoria.

The demonstration that the space between the stars contains very diffuse gases, the theoretical determination of its density and temperature, and the final proof of its uniform distribution and its participation in the rotation of the galaxy, form a striking example of the effective combination of theory and practice. The development of this interesting advance in our knowledge of the cosmos may justly be considered as one of the romances of astronomy and forms an important Canadian contribution to science.

MEDICAL RESEARCH IN SCOTLAND.

Advisory Committee Appointed.

A Scientific Advisory Committee on Medical Administration and Investigation has been appointed by the Secretary of State for Scotland.

The reference to the Committee is "to assist the Department of Health for Scotlaud in applying the results of scientific research to the details of public health administration and in promoting such medical investigations as come within the sphere of the Department or of the local authorities in Scotland." The members of the Committee are :—

Mr. Alexander Bowan, D.Sc., F.R.S.E., Scientific Superintendent, Marine Laboratory of the Fishery Board for Scotland; Professor C. H. Browning, M.D., D.P.H., F.R.S., Professor of Bacteriology, Glasgow University; Professor E. P. Cathcart, C.B.E., M.D., D.Sc., LL.D., F.R.S., Professor of Physiology, Glasgow University; Professor F. A. E. Crew, M.D., D.Sc., Ph.D. Professor of *Animal Genetics*, Edinburgh University, and Director of Animal Breeding Research Department; Sir Walter M. Fletcher, K.B.E., M.D., &c., Secretary to the Medical Research Council; Sir Robert

Greig, M.A., LL.D., M.Sc., F.R.S.E., Secretary, Department of Agriculture for Scotland; Mr. John Jeffrey, C.B., C.B.E., Secretary, Department of health for Scotland; Mr. J. Parlane Kinloch, M.D., M.R.C.P.E., D.P.H., Chief Medical Officer, Department of Health for Scotland; Mr. A. S. M. Macgregor, O.B.E., M.D., D.P.H., Medical officer of Health, Glasgow; Professor T. J. Mackie, M.D., D.P.H., Professor of Bacteriology, Edinburgh University; Professor J. J. R. Macleod, D.Sc., LL.D., M.B., Ch.B., D.P.H., Professor of Physiology, Aberdeen University; Professor Robert Muir, D.Ss., LL.D., M.D., Professor of Pathology, Glasgow University; Mr. J. B. Orr, D.S.O.,M.C. M.A., M.D., D.Sc., Director of the Rowett Institute for Research in Animal Nutrition, Aberdeen; and Professor W. J. Tulloch, O.B.E., M.D., Professor of Bacteriology, St. Andrews University.

Dr. Parlane Kinloch is chairman, and Mr. George Wallace, of the Department of Health for Scotland, is secretary of the committee.

The appointment of the committee follows on the conference of research organizations which was held in Edinburgh in November of last year and at which Mr. T. Johnston, M.P., Under-Secretary for Scotland, presided. A more intensive use of Scottish research material and the correlation of work bearing on medical as well as on agricultural, fishery, or other fields, were urged at the conference. It was also urged at the conference that a scientific advisory committee would secure the application of the most recent results of medical research.

SOCIETY OF PUBLIC ANALYSTS.

The next meeting of the Society will be held on Wednesday, December 3, at the Chemical Society's Rooms, at 8 p.m. The following papers will be read :—

"A Storage and Delivery Apparatus for Antimony Chloride Solution and other Corrosive Reagents." By G. Middleton, B.Sc., A.I.C.

"Tests for Impurities in Ether. Parts II and III." By G. Middleton, B.Sc., A.I.C., and F. C. Hymas, B.Sc., A.I.C.

"The Determination of Small Quantities of Calcium in Magnesium Salts." By Norman Evers, B.Sc., F.I.C.

"A New Method for the Detection of Nitro-Group in Organic Compounds." By P. K. Bose, D.Sc.

THE SECRET OF LEADERSHIP.

What is the secret of leadership? Dr. Charles Carpenter, President of the South Metropolitan Gas Company, stated in a recent speech that the nation lacked sufficient leaders. In a recent issue of the *Co-partnership Journal* the factors which make a man stand out as a guide and inspiration to his fellow men are discussed.

"Just where the secret lies," says the *Journal*, "is a problem that has baffled generations of men, and will probably baffle generations to come. We seem to have a dim perception that it is to be found in a perfect balance between the individual and the community; a balance that leaves the leader free to develop his own individuality to the full, but at the same time forbids him to take more from the community than he can repay to it in service. But still the mystery remains. There is consolation, however, in the fact that the real leader, when he does appear, cannot be disputed, and instantly takes his place without challenge."

EXTENSIONS IN CANADIAN METAL INDUSTRIES.

Important new development are now pending in several branches of the metal industry in Canada. The new copper refinery erected at Sudbury, Ontario, at a cost of about £1,800,000 is now in a position to supply Canadian refined metal for use for manufacturers in the Dominion. This plant, it may be recalled, is operated by the Ontario Refining Company—a joint enterprise of the International Nickel Company of Canada, the American Metal Company and the Consolidated Mining and Smelting Company of Canada.

Wires and Cables.

Metallic copper is now being supplied by the Ontario Refining Company to the Eugene F. Phillips Electrical Company, Ltd., of Brockville and Montreal, manufacturers of electric wires and cables, which concern is now about to embark upon an important programme of expansion. The Brockville plant is to be extended by the erection of five new units, the estimated cost of which will be £50,000.

SILVER PRODUCTION.

Statistics on Canadian silver production in 1929, finally revised by the Dominion Bureau of Statistics, show a production of 23,143,261 fine ounces which valued at the average price for the year, 52,993 cents per fine ounce, was worth $12,264,308, as compared with the 1928 output of 21,936,407 fine ounces, valued at $12,761,725, when the price of silver averaged 58.176 cents per fine ounce.

A small quantity of silver was produced in association with gold in the provinces of Nova Scotia and Manitoba. The Quebec output of 813,821 fine ounces was contained in blister copper made by the Noranda smelter; in gold bullion, and in exported silver-lead-zinc and copper concentrates.

Ontario produced 8,890,726 fine ounces, 82.6 per cent. of which was in the form of bullion; the remainder was contained in concentrates exported, in gold bullion produced by gold mines, in the nickel-copper ores and copper-lead-zinc ores of the Sudbury district, and in the gold and copper ores shipped to the Noranda smelter.

British Columbia's output of 10,156,408 fine ounces was smaller than in 1928. The Sullivan and Premier mines were the major producers; small recoveries were made in the refining of alluvial gold and gold bullion. Copper ores exported to foreign smelters and blister copper made at the Trail and Granby smelters contributed considerably to the provincial production.

The Yukon production of 3,279,530 fine ounces shows an increase over 1928. Increases are registered in both the placer output and in metal contained in ores and concentrates exported to foreign smelters.

ONTARIO RADIUM DEPOSITS.

Further Developments in the Hope of Proving Commercial Value.

Much public attention has recently been devoted to the possibilities of radium pro duction from a deposit located not long since near Wilberforce, Haliburton County, about 120 miles north-east of Toronto. So far this deposit has been subjected to surface examination only, but it is now intended to conduct underground work with the object of proving whether the vein carries sufficient quantities to be of commercial value. The operations are to be undertaken by the Ontario Radium Corporation, Ltd., which controls several hundred acres in the neighbourhood of the deposit. A considerable amount of work will be necessary before it is proved whether the Wilberforce occurrence can supply radium in sufficient quantity to meet Canadian requirements. The metal occurs in the form of uraninite, a crystallised form of pitchblende recognised as the richest commercial ore of radinm. Small quantities of radioactive minerals have been known in Ontario and Quebec for years, but the Wilberforce vein carrying uraninite is the first of its type yet found in Canada. The uraninite occurs as scattered crystals or nodular masses through the vein matter, some of the masses weighing several pounds. The width of the vein varies from 5 to 10 feet, and when reported upon some months ago by Mr. H. S. Spence, of the Dominion Department of Mines, had been uncovered for a length of 150 feet and traced by outcrops for a further 400 feet.

DYESTUFFS (IMPORT REGULATION) ACT, 1920.

Applications for Licences in October, 1930.

The following statement relating to applications for licences under the Dyestuffs (Import Regulation) Act, 1920, made during October, has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee.

The total number of applications received during the month was 686, of which 585 were from merchants or importers. To these should be added 6 cases outstanding on the 30 September, 1930, making a total for the month of 692. These were dealt with as follows :—

Granted—650 (of which 634 were dealt with wthin 7 days of receipt).

Referred to British makers of similar products—32 (of which 21 were dealt with within 7 days of receipt).

Outstanding on 31 October—10.

Of the total of 692 applications received, 655 or 95 per cent. were dealt with within 7 days of receipt.

Proceedings and Notices of Societies

THE ROYAL SOCIETY.

Thursday, November 6, 1930.

The following papers were read :—

The Displacement by Ultra-Violet Light of the Explosives Limit in a Chain Reaction. By C. N. Hinshelwood, F.R.S., and K. Clusius.

Mixtures of phosphine and oxygen at ordinary temperatures react negligibly slowly except between two sharply defined limits of pressure. In this region explosion occurs, the passage from the slow reaction to explosion being abrupt.

Ultra-violet light of wave-length 2,500-2,800 A diminishes the lower pressure limit.

This effect is shown to be due to the production from the phosphine of a minute amount of an active substance, which does not decay immediately when the illumination ceases. This substance increases the explosibility of the mixture by an action similar to that excited by nitrogen peroxide on mixtures of hydrogen and oxygen. The conditions of formation and decay of the active substance are investigated qualitatively and, as far as possible, quantitatively. The maximum concentration in the photo-stationary state is deduced, and the efficiency of collisions with the vessel wall in destroying it is calculated.

The oxidation provides an example of a chain reaction in which the existence of definite " material " chains rather than " energy " chains can be experimentally detected.

The Absolute Intensities and Internal Conversion Coefficients of the γ-rays of Ra B and Ra C. By C. D. Ellis, F.R.S., and G. H. Aston.

The electronic groups in the natural β-ray spectra of radioactive bodies are known to be associated by the normal photoelectric relation with the γ-rays that are emitted, but it has not been decided whether they originate by a true internal absorption of the γ-rays in the parent atom or whether there is such coupling between the nucleus and electronic system as to permit the transfer of energy without the intermediary of radiation. The experiments described in this paper were intended to give some information on this point. It is shown that measurements of the relative intensities of the natural β-ray groups and those liberated from platinum by the absorption of the γ-rays enable the magnitude of the internal conversion coefficient to be deduced. The results appear to be incompatible with a radiation hypothesis of internal conversion and indicate some other type of coupling between the nucleus and electronic system. In addition these experiments provide a method of measuring the absolute intensities of the stronger γ-rays.

On a Symmetrical Analysis of Conical Order and its Relation to Time-Space Theory. By A. A. Robb, F.R.S.

It has already been shown by the writer that the Time-Space geometry of Minkowski can be built up on a basis of *before* and *after* relations and that, contrary to the generally accepted view, congruence can be defined in purely ordinal terms.

A similar method might be applied to build up geometries of any larger number of dimensions, but the peculiarity of all such geometries is that the expression for the square of a linear interval as a sum of squares will have one square of different sign from the remaining ones.

The fact that congruence relations can be defined in purely ordinal terms for such geometries gives them a special importance which is disguised by the lack of symmetry in the canonical expression for the square of a linear interval.

In the present communication it is shown that analytical symmetry may be introduced by taking as our canonical form, not a sum of squares, but a sum of products. The analytical criteria of the *before* and *after* relations are then expressible in terms of the signs of symmetric functions of the types $\Sigma x_p x_q$ and Σx_p.

The interpretation of such a system of co-ordinates is examined and the curious result emerges that the n axes are inclined to one another at real angles equal to those made by (n—1) lines all equally inclined to one another in Euclidean geometry of (n—2) dimensions. The condition that the criteria of *before* and *after* should not be reversed in passing from one such system of co-ordinates is investigated for the case of Time-Space Theory.

Finally, the form of the wave equation is investigated for these symmetrical co-ordinate systems.

The Behaviour of Water with Change of Temperature and with Addition of Electrolytes as Studied by the Raman Effect. By Ramakrishna Rao. Communicated by O. W. Richardson, F.R.S.

Raman bands for water at different temperatures and with various concentrations of nitric acid have been studied. With increasing temperature, the band becomes sharper and shifts towards the short wavelength side. This is explained as being due to changes in the single H_2O, double $(H_2O)_2$, and triple $(H_2O)_3$ molecules, which water is supposed to consist of. At high concentrations, two sharp well-resolved bands are formed, one of which is attributed to double water molecules and the other to hydrates formed by the combination of acid and water molecules.

Energy Losses of Electrons in CO and CO_2. By E. RUDBERG. Communicated by O. W. Richardson, F.R.S.

This is a continuation of previous measurements on nitrogen in which the characteristic energy losses suffered by an initially homogeneous beam of electrons sent through the gas at low pressures were determined. The distribution curves for the electrons after passing through the gas show several well-marked maxima, the positions of which are independent of pressure and primary voltage. These maxima are characteristic of the energy levels of the particular kind of molecules under investigation. Tables are given for these characteristic energy losses in CO and in CO_2. In the case of CO the various maxima found have been correlated with transitions from the normal state of the molecule to excited states known from the analysis of band spectra belonging to this molecule or to singly ionised carbon monoxide. In those cases where a maximum has been attributed to a single electronic state, a study of the potential energy curves for the molecule shows the position of the maximum with respect to the different possible vibrational levels to be in accordance with Franck-Condon theory.

Thursday, November 13, 1930.

The following papers were read :—

Observations on Certain Physiological Processes of the Marmot. I. V. By G. ENDRES, B. H. C. MATTHEWS, H. TAYLOR, AND A. DALE. Communicated by J. Barcroft, F.R.S.

The Mechanism of Ciliary Movement. By J. GRAY, F.R.S.

The Contraction of the Extrinsic Muscles of the Eye by Choline and Nicotine. By W. S. DUKE-ELDER AND P. M. DUKE-ELDER. Communicated by C. Lovatt Evans, F.R.S.

A Cytological Demonstration of "Genetic" Crossing-Over. By C. D. DARLINGTON. Communicated by Sir Daniel Hall, F.R.S. The author exhibited models to illustrate this paper.)

The Differential Action of X-rays on Tissue Growth and Vitality, II, III, IV. By W. MOPPETT. Communicated by J. T. Wilson, F.R.S.

Prothrombase Its Preparation and Properties. By J. MELLANBY, F.R.S.

The Porphyrin of Component c of Cytochrome and its Relation to other Porphyrins. By R. HILL AND D. KEILIN, F.R.S.

The Isolation by Cataphoresis of two Different Oxy-hæmoglobins from the Blood of Some Animals. By A. GEIGER. Communicated by H. H. Dale, Sec. R.S.

The Development and Vascularisation of the Corpus Luteum in the Mouse and Rabbit. By R. DEANESLY. Communicated by J. P. Hill, F.R.S.

SOCIETY OF PUBLIC ANALYSTS.

An Ordinary meeting of the Society was held at the Chemical Society's Rooms, Burlington House, on Wednesday, November 5, the President, Dr. J. T. Dunn, being in the chair.

Certificates were read for the first time in favour of Arthur Nicholls Ainsworth, B.Sc., Bertram Arthur Gough, William Henry Gough, M.Sc., A.I.C., William Henry Shilling, B.Sc., A.I.C.

Certificates were read for the second time in favour of Leonard Balmforth, B.Sc., F.I.C., Reginald Joseph Cole, B.Sc., Violet Dorothy Dudman, B.Sc., A.I.C., Frank George Edmed, O.B.E., B.Sc., A.R.C.Sc., F.I.C., Roy Gardner, D.Sc., F.I.C., William Victor Griffiths, B.Sc., A.I.C., Daoud Younis Haddad, B.Pharm, Percy George Terry Hand, F.I.C., Magnus Herd, B.Sc., A.R.T.C., F.I.C., Gilbert Underwood Houghton, B.Sc., A.I.C., Archibald Robert Jamieson, B.Sc., F.I.C., William Jefferys Lesley, M.Sc., Ph.D., A.I.C., Allison Reginald Murray MacLean, B.A., M.Sc., Ph.D., Frederick Henry Newington, F.I.C., Colin Paterson, B.Sc., A.I.C.

The following were elected Members of the Society :— John Herbert Bushill, M.Sc., A.I.C., Edward Quentin Laws, B.Sc., A.I.C., and Hubert Taylor, B.Sc., A.I.C.

The following papers were read and discussed :—

The Analysis and Composition of Vegetable Parchment used for Packing Dairy Products. By P. ARUP. M.Sc., F.I.C.

vegetable parchment commonly in use for the packing of butter has been made. Methods for determining moisture, ash, foreign matter, water-soluble extract, and reducing substances are described, and standards based upon the results are tentatively suggested.

The Determination of the Milk Proteins. By G. M Moir, M.Sc., Ph.D., A.I.C.

This work gives the results obtained by the author in the investigation assigned to him as Pedler Research Scholar of the *Institute of Chemistry.* The chemistry and separation of casein is first discussed, and it is shown that by mixing definite quantities of milk with a suitable acetic acid and sodium acetate buffer, maximum casein values are obtained between pH 4.5 and 4.7. Casein thus precipitated has been proved to be identical with the substance precipitated by acetic acid alone at pH 4.2. For the combined determination of albumin and globulin the filtrate obtained from the iso-electric precipitation of the casein is treated with trichloroacetic acid to give a concentration of about 4 per cent., and the nitrogen in the resulting precipitate determined by Kjelhahl's method. Casein and globulin are determined by precipitation with neutral saturated magnesium sulphate or sodium sulphate, and the individual proteins calculated by differenee.

The Lead Reduction Method for the Volumetric Determination of Tin, and the Interference of Copper and Antimony. By S. G. Clarke, B.Sc., Ph.D., A.I.C.

Tin is determined by Powell's method of reduction from the stannic condition by means of lead, and direct titration with iodine, the reduction and titration being carried out in an atmosphere of carbon dioxide in the apparatus devised by B. S. Evans. The effect of copper is to cause the results for tin to be too low in direct pro portion to the amount of copper present. Antimony also interferes, a considerable amount of tin being removed from the solu tion by the precipitation of the antimony; this reacts with the iodine during the titration.

A New Method for Determining Traces of Chromium in Steel. By W. J. Agnew, B.A.

A very accurate method of determining chromium in steel consists in oxidising it with potassium permanganate, and reducing the excess of permanganate by means of hydrochloric acid. The iron is then precipitated with sodium carbonate, and the dichromate determined by Evans' colorimetric method based on the purple coloration which it gives with diphenylcarbazide, a N/1000 solution of potassium dichromate being used as the standard.

MINERALOGICAL SOCIETY.

Anniversary Meeting, November 4, 1930.

The following were elected officers and members of Council :—

President—Sir John S. Flett; *Vice-Presidents*—Dr. G. F. Herbert Smith, Prof. C. Gilbert Cullis; *Treasurer*—Mr. F. N. Ashcroft; *General Secretary*—Mr. W. Campbell Smith; *Foreign Secretary*—Dr. J. W. Evans; *Editor of the Journal*—Dr. L. J. Spencer; *Ordinary Members of Council*—Col. N. T. Belaiew, Mr. Harvey Collingridge, Mr. Henry Dewey, Prof. Arthur Holmes, Dr. A. Brammal, Mr. G. McDonald Davies, Prof. W. G. Fearnsides, Miss M. W. Porter, Mr. A. F. Hallimond, Dr. F. H. Hatch, Sir Albert E. Kitson, and Prof. W. L. Bragg.

The following papers were read :—

An Account of British Mineral Collectors and Dealers in the 17th, 18th and 19th Centuries. By Arthur Russell.

A first instalment of a series of short biographies dealing with :— Nehemiah Grew, F.R.S. (1641-1712); William Borlase, F.R.S. (1696-1772); Rudolf Eric Raspe (1737-1794); and Philip Rashleigh, F.R.S. (1729-1811).

On Cuperiferous Melanterite from the Skouriotissa Mine, Cyprus. By M. H. Hey.

A crystallographic study of a well-crystallised specimen from an ancient working (perhaps Roman) in the Skouriotissa mine, revealed a very peculiar habit tabular to $b(010)$, and the presence of the new forms $x(161)$, $y(231)$, $g(112)$, $q(102)$, and $\beta(150)$. A partial analysis shows the presence of 7.7 per cent. $CuSO_4, 7H_2O$.

On the Dolerite-Chalk Contact Zone of Scawt Hill, Co. Antrim. By Dr. C. E. Tilley.

The production of basic alkali rocks by the assimilation of limestone by basaltic magma. (With chemical analyses by Dr. H. F. Harwood).

Assimilation of limestone at the contact of a dolerite intrusion with the chalk, at Scawt Hill gives rise to a hybrid zone built up of pyroxene-rich rocks (pyroxenites), titanaugite-melilite rocks, and basic rock-types bearing nepheline, (theralite and

nepheline-dolerite assemblages). The segregation of a basic alkali residuum is the complementary process in the precipitation of magnesian rich pyroxene in the pyroxenites. Plagioclase is resorbed and gives place to a titaniferous lime-augite rich in alumina, melilite and nepheline, while perovskite, aegirine, and wollastonite are other products in the hybrid zone.

A Simple Method of Observing the Magnetic Properties of Mineral Grains. By Dr. Frank Smithson.

The tests are made with softened steel needles attached to the poles of a horse-shoe magnet, a strong field being obtained when the points are 1 mm. or so apart. The attraction is observed under the microscope.

On Studies of the Zeolites. Part I. General Review. By M. H. Hey.

A short review of the general properties of the zeolites, with some suggestions on the interpretation of the available data, and a comparison of the zeolites with the clays, ultramarines, permutites, and " artificial zeolites."

ROYAL GEOGRAPHICAL SOCIETY'S CENTENARY.

This year the Royal Geographical Society has attained the hundredth year of its existence. The celebration of the centenary has recently taken place and several important addresses have been delivered by prominent members of the Society.

Dr. Albrecht Penck (Berlin) whose subject was " The Alleged Desiccation of Central Asia," described the physical and climatic features of Asia, and agreed with other explorers that there was no desiccation of Central Asia, that there were only local oscillations of climate, and that during the last 7,000 years there had been on considerable change. There was much scientific work to be done in Central Asia, and he hoped the Royal Geographical Society would make further progress in that field, in addition to what had been done in the last 100 years.

Professor J. W. Gregory addressed the gathering on " The Stability of Climate in Palestine in Historic Times." The overwhelming weight of expert opinion was that there had been no change in the climate of Palestine within historic times. Palestine had been in recent times an arid semi-desert with a small, poor population. Ancient Palestine, on the contrary, was represented as a fertile, densely peopled country flowing with milk and honey, well forested, and with many populous towns. The change had been attributed to a decrease in the rainfall and a failure in the water supply. The strongest part of the case for the former greater rainfall in Palestine rested on the ruined cities, but the evidence of the decadent and derelict towns did not appear conclusive of climatic change. Their decline was probably due to political and commercial changes. The Bible showed that throughout the period it recorded the weather conditions in Palestine were the same as existed there to-day. It gave no evidence of greater rainfall, except for occasional years, or of a more fertile soil, and the country was always liable to droughts and famines.

The most precise test of the Palestine climate was given by the vine and the palm. Palestine was on the northern edge of the zone where the date palm bore fruit. The palm grew in Palestine, as in Greece and the south of France, but it did not bear dates, except along the coast and in the torrid depression of the Dead Sea.

A lecture on " East Africa. Past and Present," was given by Mr. L. S. B. Leakey. The habitability of East Africa at the present day was controlled, so far as the African was concerned, almost entirely no doubt whatever that its potential habitability had greatly decreased since the Neolithic period, since vast areas which could then carry a big permanent population could only now carry a small permanent one or a nomadic one. The position of the white settler was a far stronger one because, unlike the primitive African, he had available all sorts and methods of water conservancy. Therefore the habitability of East Africa, so far as the white man was concerned, was not controlled by the water factor in the same way. But it had not been proved yet that East Africa was a white man's country.

Addresses on the history of the Royal Geographical Society were given on October 21st.

Colonel Sir Charles Close, the president, who drew a picture of the foundation meeting on July 6th, 1830, said that they were still proud to number among their Fellows statesmen and men of science, travellers and writers, soldiers and sailors, and all who took a lively interest in their subject.

Sir Francis Younghusband and Lord Zetland also spoke.

NOTICES OF BOOKS.

The Mysterious Universe. By SIR JAMES JEANS, M.A., D.Sc., F.R.S. Pp. x + 154. Cambridge University Press. 1930. Price 3s. 6d.

Prof. Sir James Jeans' latest work will be welcomed by all scientists and thoughtful men, for it explains and expresses with clarity the point of view to which we are led by the advance of science in all its branches.

Sir James, an astronomer, begins by indicating in the chapter, *The Dying Sun*, the birth of the solar system, which occurred some two billion years ago. From this he goes on to the question of the origin, occurrence and future of life in the universe. Life can exist only inside a narrow zone which surrounds each star at a very definite distance. Outside these zones life would be frozen; inside it would be shrivelled up. At a rough computation, these zones within which life was possible, all added together, constituted less than a thousand million millionth part of the whole of space. And even inside them life must be of very rare occurrence, for it was so unusual an accident for suns to throw off planets as our own sun had done that probably only about one star in 100,000 had a planet revolving round it in the small zone in which life was possible. It seems incredible that the universe can have been designed primarily to produce life like our own; had it been so surely we might have expected to find a better proportion between the magnitude of the mechanism and the amount of the product. At first glance at least life seems to be an utterly unimportant by-product; we living things are somehow off the main line. And this impression is only strengthened when we attempt to pass from our origins to an understanding of the purpose of our existence, or to foresee the destiny which fate has in store for our race.

Just as Tantalus, standing in a lake so deep that he only just escaped drowning, was yet destined to die of thirst, so it is the tragedy of our race that it is probably destined to die of cold, while the greater part of the substance of the universe still remains too hot for life to obtain a footing. The evidence of Physics pointed in the same direction. The second law of thermo-dynamics predicted a "heat-death" for the world by uniformly distributing the energy of the universe.

Summarising the tendencies of modern physics, the author alludes to the quantum theory and the two types of "waves." Bottled-up waves are matter as we recognise it and unbottled waves are radiation or light. When matter is annihilated, imprisoned wave energy is released and can travel through space. These concepts reduce the whole universe to world of light, potential or existent, so that the story of the creation can be told in the six words: "God said: 'Let there be Light.'"

Whilst it cannot be asserted that modern physical and scientific knowledge is in any way final it does seem that in this work Sir James Jeans has indicated the present state of our knowledge of this mysterious universe.

Elementary Quantitative Analysis. By WILLIAM BRIGGS, LL.D., M.A., B.Sc., AND H. W. BAUSOR, M.A., F.I.C. Revised by D. R. SNELLGROVE, Ph.D., M.Sc., A.I.C. Second Edition. Pp. 125. London: W. B. Clive, University Tutorial Press. 1930. Price 3s.

This well-known text book on Quantitative Analysis for beginners is primarily intended for students taking practical chemistry examinations of the standard of Intermediate University Examinations, but will also serve as an introductory work for any students of quantitative inorganic chemistry.

The first section covers simple volumetric exercises in neutralisation, oxidation and reducton and precipitation. The second section includes a number of simple gravimetric analyses. Attention has been paid to the numerous practical details and a student who follows carefully and intelligently the directions given should soon acquire enough skill to ensure accurate results.

A new chapter dealing with the preparation of pure substances has been incorporated in this, the second edition. The book should prove useful not only to students and beginners, but also to lecturers and demonstrators.

Forthcoming Events.

ROYAL SOCIETY OF ARTS.
John Street, Adelphi, W.C.2.
Wednesday, November 26, at 8 p.m.—"The Chemical Constitution of Coal." By Prof. William A. Bone, D.Sc., Ph.D., F.R.S.

THE PHYSICAL SOCIETY.
Friday, November 21, at 5 p.m., at the Imperial College of Science, Imperial Institute Road, South Kensington.—Ordinary Meeting.

THE ROYAL INSTITUTION.
21, Albemarle Street, W.1.
Tuesday, November 25.—"Two Old Friends of the Royal Institution. I. William Spottiswoode. II. Warren De La Rue." By Sir William Bragg, K.B.E., M.A., F.R.S., M.R.I.
Thursdays, November 20 and 27. —"Colour Vision." By L. C. Martin, D.Sc., A.R.C.S.

THE SOCIETY OF DYERS AND COLOURISTS.
MANCHESTER SECTION.
Friday, November 21 at 7 p.m., at 36, George Street.—"Some Remarks on the Treatment of Aniline Black Subsequent to Ageing." By Dr. I. L. Hankey.

ROYAL INSTITUTE OF PUBLIC HEALTH.
Wednesday, November 26, at 4 p.m., in the Lecture Hall of the Institute, 37, Russell Suare, W.C.1.—"The Prevention of Accidents in Factories and Workshops." By L. Ward, O.B.E.

INSTITUTE OF CHEMISTRY.
Mr. Bernard F. Howard, Vice-President, will deliver the Streatfeild Memorial Lecture at the Institute, 30, Russell Square, London, W.C.1., on Friday, 21 November, 1930, at 8 p.m. Subject: "Some Notes on the Cinchona Industry." Dr. G. C. Clayton, C.B.E., President, in the chair.

OIL AND COLOUR CHEMISTS' ASSOCIATION.
Manchester Section.
The Section will hold its Sixth Annual Dinner and Dance at the Manchester, Ltd., Royal Exchange, Manchester, on Saturday, November 22, at 6.30 p.m.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

32,236.—(I. G. Farbenindustrie Akt.-Ges.).—Manufacture of complex compound of arsonic acids. Oct. 27.

32,394.—(I. G. Farbenindustrie Akt.-Ges.).—Manufacture of anthraquinone-1-aldehyde &c. Oct. 28.

32,405.—(I. G. Farbenindustrie Akt.-Ges.).—Manufacture of 3-hydroxy-diarylamine-5-carboxylic acids &c. Oct. 28.

32,523.—(I. G. Farbenindustrie Akt.-Ges.).—Manufacture of ortho-amino-para-cresol-carboxylic acid. Oct. 29.

Specifications Published.

310,415.—British Celanese, Ltd.—Apparatus for carrying out chemical reactions.

336,991.—Harrison, C.F.R., and Imperial Chemical Industries, Ltd.—Destructive hydrogenation.

337,109.—(I. G. Farbenindustrie Akt.-Ges.).—Manufacture and production of phosphoric acid and hydrogen.

337,299.—I. G. Farbenindustrie Akt.-Ges.—Manufacture of N-substituted benzimid-azolone-arsinic acids.

Abstract Published.

335,007.—Dicalcium phosphate. Holz, A., 18, Sherman Place, Irvington, New Jersey and Berdell, T. van D., 39, Broadway, New York, both in U.S.A.

Dicalcium phosphate; phosphoric acid. A process for the production of dicalcium phosphate comprises forming a mixture of hydrochloric and sulphuric acids in equivalent amounts, treating rock phosphate with this mixture, removing calcium sulphate from the mixture of phosphoric acid and

calcium chloride so formed and treating the filtrate with alkali metal, for instance, sodium, hydroxide and calcium hydroxide, thereby forming dicalcium phosphate, and a solution of alkali metal chloride. The mixture of acids is obtained by electrolysing a solution of the alkali metal chloride, and passing the chloride evolved with an *equivalent amount of sulphur dioxide* into water. The alkali-metal hydroxide formed may be employed in the process. In a modification of the process, the filtrate of phosphoric acid and calcium chloride, after concentration, may react upon more tricalcium phosphate, and sodium hydroxide then added.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

BLOODIT.

515,821.—Chemical substances in class 1 for use by block makers in the manufacture of printing blocks.—Johnson & Sons, Manufacturing Chemists, Ltd., Hendon Way, Hendon, London, N.W.4. Nov. 5th.

NERAN.

516,538.—Chemical substances used in manufactures photography or philosophical research and anti-corrosives. —British Dyestuffs Corporation, Ltd., Hexagon House, Blackley, Manchester. November 5th. (Associated.)

SELFATIC.

514,602.—All goods in class 1 which includes chemical substances used in manufactures, photography or philosophical research, and anti-corrosives.—Produits Chemiques & Agricoles Societe Anonyme, 42, rue de Geneve, Lausanne, Switzerland. Nov. 5th.

CARDICE.

516,211.—Carbon dioxide in solidified form, for use as a refrigerant.—The Carbon Dioxide Co., Ltd., Union Marine Buildings, 11, Dale Street, Liverpool Nov. 5th. (Associated)

GRAMMAR OF LOGIC.

100 Questions and Answers on The Grammar of Logic or *How to Reason Correctly.* By J. E. Roscoe, M.A., Oxon.

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NOTICE TO AUTHORS & CORRESPONDENTS

Contributions for publication either as original articles or in the correspondence columns are welcomed by the Editor of *The Chemical News.*

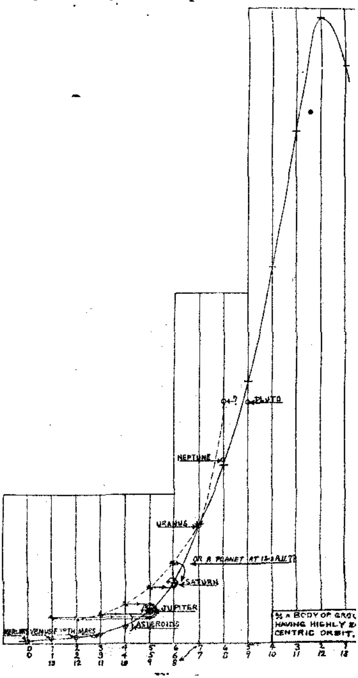
They must be accompanied by the contributors' full names and addresses, not necessarily for publication, but as an indication of good faith. If a reply is needed or if it is desired that a manuscript which is not accepted for publication be returned, a stamped addressed envelope should be enclosed.

No notice can be taken of anonymous•

AN IMPROVED BODE'S LAW AND THE TRANS-NEPTUNIAN PLANETS AND THE ORIGIN OF THE SATELLITES.—PART II.

By F. H. LORING.

In the last article, titled as above, this volume, page 289, Fig. 1 shows the extensiou of the top curve below Uranus; but this extension was only drawn as an approximate extrapolation. If the whole curve be plotted according to the series values as shown on Fig. 1A below, then the up-and-down series is practically eliminated and curves are obtained as before except that the broken part below Uranus falls higher up and intersects ordinates giviug values which may be taken as suggestive of satellite formations of the middle planets, assuming that the orbits are highly elliptical in order to have the bodies capturable by the said planets.



SCIENCE AND MODERN INDUSTRY.

By Professor Sir William J. Pope.

The Sixth Annual Norman Lockyer Lecture, Delivered on November 13, in the Hall of The Goldsmiths' Company.

Twenty-five years ago, the late Sir Joseph Norman Lockyer created the British Science Guild as a corporate organisation for the continued promulgation of certain principles for which he had himself worked throughout a long and busy life. He saw clearly the necessity for applying the methods of scientific inquiry to human affairs of every kind and for bringing science into close contact with all the many phases of our national life. The Guild has consistenly striven, and not without success, to secure a wider recognition of the principles underlying the views held by its founder. It is perhaps not unfitting to-day, just ten years since Sir Norman Lockyer passed from among us, that I should ask your consideration of a few matters to which the principles of the Guild still seem to be inadequately appplied.

Many thousands of years since, at a time prehistorically distant, man existed on this planet as a creature practically indistinguishable, physically and mentally, from his descendauts of to-day. The evidence which proves that modern man is to no appreciable degree the intellectual superior of his predecessor who lived in the far fringe of historic time is overwhelming. Thousands of years since, languages were invented which were probably more expressive and flexible than any modern tongue; great literatures sprang into being, depicting every human emotion and aspiration with a delicacy and perfection which still remain unsurpassed. Five thousand years ago the goldsmith and the sculptor were producing gems of art of such loftiness of conception and skill in execution as to defy modern competition. It may indeed be asserted that in many of the arts, in literature and perhaps also in such abstract subjects as moral philosophy, no progress has been made for many centuries past ; no novel conception has been introdueed and the only change consists in the re-presentation of the age-old material in a form which meets the taste of the current period. This observed absence of progress in many branches of intellectual activity seems to force upon us a somewhat curious conclusion : the conclusion that certain forms of intellectual expression were worked out thousands of years ago to the utmost limit of the capacity of the human intelligence. Progress can only be made in those subjects through some development of the human intelligence which will involve its acquisition of fresh powers entirely different from any which it now possesses. What those developments may be must naturally re main quite insensible to the fine arts : no part of our intellectual equipment is capable of grasping them.

We may consider a few of the ways in which the scientific age differs, and will as time goes on differ still more, from those which have preceded it. Until the invention of the locomotive and the steamship, the speed of travel and of transport had remained practically the same since prehistoric days ; it was the rate of progression of a pedestrian, a horseman, a horse-drawn vehicle, or a sailing ship. To-day we can travel by air at a speed of 100 miles an hour in comparative safety and, since the scientific study of air travel is proceeding apaee ,such risks of disaster as still attend the new mode of transport must soon practically disappear. From prehistoric times and until the introduction of the electric telegraph, messages could travel no faster than a horse, although a little speeding up by the aid of bonfire signals or rudimentary semaphores was occasionally possible. To-day, the spoken word can be transmitted all over the world in a fraction of a second by wireless telephony ; the time is not far distant when we shall be able to see events actually occuring on the other side of the world whilst still sitting in our homes. Only a century ago, a surgical operation was exquisitely painful and very often fatal; the introduction of anaesthetics has abolished the pain and that of antiseptics has minimised the risk. Not many years since, careful observers warned us that the gradual increase in the world's population was leading us towards a world shortage of vegetable, and consequently of animal foodstuffs ; during the last few years great chemical factories have been established for the application of scientific discoveries to the manufacture of fertilisers from the nitrogen of the air. So rapid has progress been in this direction that not only has the danger of an imminent grain shortage been removed but the world's capacity for producing artificial fertilisers has outstripped the demand. This, of course, is but a passing phase and as scientific agriculture

becomes more widespread, with a consequent raising of the standard of living in many parts of the world, the whole of the possible output of fertiliser should be absorbed.

In 1856, our fellow-countryman, the late Sir Wm. H. Perkin, made the first coal-tar dyestuff, Perkin's Mauve ; this important discovery was quickly followed by others of a similar kind, and, at the present day, more than 1,000 distinct coal-tar dyes are now manufactured which are more permanent and pure in colour than any naturally occurring dye-stuff. For many years a flourishing coal-tar colour industry existed in this country, but gradually, and for reason which need not be now discussed, pre-eminence in the coal-tar industry passed to Germany; at the outbreak of the war this country was only producing about one-fifth of the dyes required by its great textile industries. It should be noted that the dye-stuff industry is complicated by the fact that it uses large numbers of its intermediate substances, many of which were imported, and that many of its intermediates and finished products are essential to other industries, such, for instance, as those concerned with the manufacture of photographic materials and pharmaceutical products ; it is, in fact, a key industry in the sense that its failure involves the breakdown of other and larger industries. In time of war, coal-tar colour works can be quickly reorganised for the manufacture of high explosives and other munitions. At the outbreak of the great war one dye-stuff intermediate, toluene, essential in the manufacture of the high explosive, trinitrotoluol, was produced in but small quantities in this country and, owing to lack of plant and other facilities, a long delay ensued before reasonable supplies could be obtained from coal-tar. Fortunately, it was found possible to secure large supplies of a particular kind of petroleum from Borneo which contained a high percentage of toluene ; this proved a valuable auxiliary, especially during the early days whilst the work of organising the large scale separation of toluene from coal-tar and coal-gas was in progress.

The intolerable situations in which the British coal-tar industry found itself in 1914 was quickly recognised, and in March, 1915, a new manufacturing company, British Dyes, Ltd., was formed with considerable financial aid from the Government ; although the activities of the Company in the field of dyestuff manufacture at once became subservient to national needs for explosives, fairly large quantities of the more common dyestuffs were produced. At about the same time another dye manufacturing concern, Scottish Dyes, Ltd., was started as a private company and has done valuable service in developing the manufacture of the more costly and permanent of the coal-tar dyes.

As has just been indicated, the Government was impressed in 1915 by the necessity for a strong British dyestuff industry, and the sympathy thus aroused found practical expression in the granting of large financial assistance. The Government attitude was maintained during succeeding years and in 1918 the following official pledge was given : "In order to safeguard this particular industry against the great efforts which the great German dye-making firms are certain to make after the war to destroy all accomplished through the war, and to make this again subservient to Germany. . . . importations of all foreign dyestuffs shall be controlled by a system of licenses for a period of not less than 10 years after the war." Ultimately the Dyestuffs (Import Regulation) Act came into effect as from January 15th, 1921, after the following Government declaration had been made : "It is the settled opinion of the Government that for National security it is essential that synthetic colour-making factories should be in existence, and be maintained in operation with their staffs of chemists and other experts in this country, and that the equipment should be equal in extent to that of any other possible hostile nation. It is the settled opinion of the Government that this should be brought about without placing the textile and other colour-using industries in an unduly disadvantageous competitive position." These very definite statements of the settled Government opinion were translated into a very uncompromising action in the Dyestuffs Act. The Act prohibits the import of all dyestuffs and intermediates used in their manufacture except when no British equivalent is available, or when a British equivalent is on offer only at a higher price than the foreign equivalent. It would be difficult to find a parallel in peace-time legislation to so drastic an enactment, but yet the Dyestuffs Act seems to have worked with very little friction ; it has certainly had fundamentally important consequences, a few of which may be pro-

fitably noted. Under the shelter of the Act the economical manufacture of dyestuffs has developed rapidly in this country. Whilst in 1913 we manufactured only about 20 per cent. of the dyestuffs required in our textile industry, and that amount mainly from imported intermediates, we now manufacture about 93 per cent. of our total consumption and largely from home-produced intermediates. Further, as the British firms have succeeded in producing dyestuffs not previously manufactured here, prices have shown an astonishing diminution. Thus, one particular dye when made only in Germany was sold in England at 37s. 6d. per pound, but when it had been successfully produced at home the quotation fell to 15s. per pound ; the price of another fell under similar conditions from 12s. 6d. to 6s. 4d. per pound and yet another from 9s. 6d. to 3s. per pound. Since these colours are consumed in large quantities it is clear that the textile industry has in the past been paying heavy toll to the German manufacturers in the form of huge profits on monopoly articles.

Since modern industry is highly scientific in character it would seem to follow that an early education in science is well calculated to fit a young man to take up an industrial career ; it is indeed noteworthy that during recent years the number of science students who secure important appointments on the administrative side of industry has been rapidly increasing. It may well be questioned whether the school education of to-day is a satisfactory one for the lad who intends to devote himself to either science or productive and progressive industry. Two totally distinct subjects have here to be considered, namely education and instruction. Education consists in expanding the powers and resources of the mind whilst instruction consists in filling it with information ;it is much more easy to instruct than to educate. The young intelligence is naturally so receptive and the young memory can be so easily trained that an alert lad of eighteen years of age is generally capable of absorbing information at a prodigious rate and of retaining it for a time with remarkable tenacity. The trained memory is one of the most astonishing things in nature and its existence has given rise to the school cramming system which is now, and has long been, so prevalent ; the evils of school cramming may be illustrated by an example. During the last hundred years organic chemistry has developed as a vast body of carefully determined experimental observations held together and co-ordinated by an elaborate network of theory ; whilst it thus presents itself to us as one of the most ingenious and elaborate schemes of scientific classification, it remains experimental in character and reposes upon the broad principles of general chemistry. The competent organic chemist must, in fact, be essentially an experimenter and be so thoroughly imbued with the general principles of natural philosophy that that knowledge has become instinctive. The attainment of a mastery over general principles is a slow process since it involves education, and the learning of experimental methods calls for long and laborious laboratory training, but the cramming up of the theoretical part of organic chemistry offers an easy task to the youthful trained memory. I repeatedly find young men entering the University already equipped with a sufficient knowledge of theoretical organic chemistry to see them through the honours degree examination which they are to take some years later; they bring with them sets of notes on the subject in which parts are sometimes underlined in red ink as indicating matters on which the examiners may be expected to ask questions. Whilst the young man is so satiated with all this detail that he is stale and weary of science he has generally had little laboratory training and his elementary education has often been deplorably neglected; his handwriting and spelling are frequently execrable and his knowledge of the great leading facts and ideas underlying chemical science is often very imperfect. Furthermore, it is rare to find a young science student who can read any continental language with ease and rarer still to find one who can understand a spoken foreign tongue.

Now the subject matter of modern science is distributed in a very indiscriminate manner among several languages, principally English, French and German; the modern industrialist is in close contact with his continental competitors. The student who is not fluent in the three great modern languages is heavily handicapped. During frequent visits to the Dutch Universities I have observed that the young science students often speak English, French and German with great fluency and correctness; in response to questioning I am always told

by these young Dutch men and women that they have learnt their several foreign languages in the schools. Strange as it may seem to an English audience, accustomed to English school methods, it is quite easy for a boy to learn several foreign languages at school, and this to a degree of perfection which impels the young person towards an enjoyment of foreign literature. Of course, our Dutch friends have been forced by their geographical environment into this astounding development of their scholastic educational methods; it would be difficult, however, to over-estimate the cultural value of an educational system which produces such results. It must be conceded that our present-day English school system, the most expensive in Europe, calls loudly for revision; modern science and modern industry demand recruits who have received a liberal education. Much has to be undone and redone when the schools send to the University or to the industries young men who cannot express their thoughts grammatically in writing but who are stuffed with facts relating to highly specialised branches of science.

There is little to indicate that a rationalisation of our educational methods is in progress. The country has at present before it a scheme for raising the school leaving age to fifteen years. Now those who have to deal much with the young must realise that many, from all classes of society, are endowed with so poor a mental equipment that all but the rudiments of education are wasted upon them; they would benefit by leaving school towards the age of twelve. Others, again drawn from every stratum of society, are intellectually so gifted that their education may be profitably extended until well into the twenties. The democratic appeal for equal chances for all is unscientific, for nature has not given equal potentialities to all. To prolong school contact between the dullard and the gifted is unprofitable to the former and must retard the development of the latter.

CONDITION OF THE CHEMICAL TRADE.

Conditions in the chemical trade (says *British Industries*) seem to have reached a fairly constant level, and while no outstanding improvements can be reported there are no signs of any further falling off in the volume of business. If anything, there is rather more confidence among buyers and a feeling that the worst of the trade depression is over is noticeable in many quarters.

CHEMICAL INDUSTRY IN RUSSIA.

Practically the whole of the chemical industry of the U.S.S.R. is controlled by the State All-Union Association of the Chemical Industry "Vsekhimprom," which was established in accordance with the decision of the Council for Labour and Defence of January 13, 1930. The aim of the Association is to elaborate plans, regulate, administer, and control technically the chemical industry, to obtain special kinds of raw materials, and to manufacture various chemicals and products of the coal-tar distillation industry. It supplies the various chemical enterprises with raw materials, fuel, machinery and equipment ; it elaborates plans and supervises the erection of new factories and works ; organises and supervises scientific research and technical work in the chemical and coal-tar distillation industry ; it supervises all matters in connection with the supply of labour, technical standardisation, rates of remuneration, the safeguarding of labour, the training and supply of workers; and organises the exports of chemicals. Its share capital is 321 million roubles. The Association is controlled by the Supreme Economic Council of the U.S.S.R.

The following trusts and syndicates are amalgamated in the "Vsekhimprom":—

The All-Union State Syndicate of the Chemical Industry "Khimsyndicate," which was the selling organisation of the producing trusts.

The State Limited Liability Company "Khimstroy" for the construction of new chemical factories and works, with a share capital of 2,900,000 roubles.

The State Special Technical Office for the rationalisation of the chemical industry of the U.S.S.R. "Orgkhim."

Ukranian State Trust of the Basic Chemical Industry "Ukrkhimtrust," with a share capital of 74,400,000 roubles, engaged in the production of inorganic chemicals, acids, alkalies, fertilisers, superphosphates, aniline dyes, and other products.

The State Central Trust of the Basic Chemical Industry "Centrokhimtrust," with a share capital of 49,000,000 roubles, engaged in the production of acids, alkalies, salts and sulphate ammonium fertilisers.

The State Northern Chemical Trust "Sevkhim trust," with a share capital of 44,100,000 roubles, egaged in the production of acids, alkalies and fertilisers ; controls the chemical enterprises in the Urals and the Volga area.

The State Trust of the Aniline Dye Industry "Aniltrust," with a share capital of 33,700,000 roubles. This trust is the principle producer of organic dyes and intermediary products.

The State Trust of the Coal Tar Industry "Koksobenzol," with a share capital of 64,400,000 roubles. The Trusts is engaged in the production of coal tar products and nitrogen fertilisers.

The State Trust "Lakokraska," with a share capital of 9,900,000 roubles, producing a large variety of paints and varnishes.

The State Trust for Wood Distillation "Lesokhim," with a share capital of 9,400,000 roubles. This Trust controls the largest factories for wood distillation and for the production of resin and turpentine.

The Leningrad State Chemical Trust "Lenkimtrust," with a share capital of 21, 800,000 roubles, making basic chemicals, paints and varnishes.

The State Trust for the Production and Sale of Laboratory Equipment "Goslaborsnabzhenye," with a share capital of 5,700,000 roubles.

Other members of the Association include organisations for the exploitation of the huge mineral resources of the country. Such, for iustance, is the State Potash Trust "Kalitrust," established to mine the potash deposits of Solikamsk. So far, an area of more than 600 square kilometres has beeu prospected, and the potash deposits are estimated to be hundreds of millions of tons. To each square metre of surface there are approximately 10 tons of potash. The first shaft was sunk in 1927, and the second in May, 1928. At present the construction and equipment of the first mine is being completed, and a refining factory, a railway, and docks are being built. In October of the current year a new shaft is to be sunk. A total of 30,000,000 roubles has already been invested and it is estimated that the output of potash in 1932-33 will reach 1,500,000 tons. A new trust, the State Khibinsk Apatite Nepheline Trust "Apatite," has been established, to mine the apatite (phosphate) and nepheline deposits in Khibin on the Kola Peninsula. The Karabugas Sulphate Trust is working the natural sulphate reposits on the banks of the Karabugas Gulf in the Caspian Sea.

For the direct control of the enterprises which are united in "Vsekhimprom" a supervising administration has been established with all the powers of a trust.

The Association also controls the State Scientific Research Institute for Applied Chemistry, the State Scientific Institute for Fertilisers, and the State Chemical Institute for Hard Fuels.

In the past few years the State Chemical industry has achieved important success in its development in individual branches as well as in the activities of a number of trusts. The following shows the value of the output in thousand roubles of the various branches.

	1927-28	1928-29
Basic Chemicals	81,559	104,814
Paints and Varnish	44,788	53,896
Aniline Dyes	34,649	42,212
Wood Distillation	8,529	14,347
Coal Tar	18,357	22,212

The gross output of the principal Acids, Alkalies, Salts and Fertilisers and chemical products in tons is shown in the following table :—

	1927-28	1928-29
Sulphuric acid	228,810	301,786
Hydrochloric Acid	54,097	53,987
Soda Ash	207,271	229,992
Caustic Soda	55,827	63,805
Potash	6,057	6,870
Sodium Bichromate	3,276	3,450
Copper Sulphate	2,912	5,537
Superphosphates	151,683	196,421
Ammonium Sulphate	13,412	19,023

Productions in the first half of the 1929-30 financial year shows a considerable increase in certain products over 1928-29; e.g., the output of soda ash was 127,438 tons, or superphosphates 163,196 tons, and of copper sulphate 4,048 tons. In spite of this increase the requirements of the home markets are so extensive that Soviet industry is not supplied to the full extent with the chemicals it requires.

ANILINE DYES AND SEMI-MANUFACTURES.

The production of dyes in the principal factories increased in 1928-29 by 26-30 per cent. as compared with the preceding year, while for certain commodities an increase of 60 per cent. was registered. Still larger developments are anticipated in the year 1929-30.

At present the Aniltrust manufactures a number of compound intermediary products.

The development of the production of dyes can be seen from the following table showing output in tons :—

	1927-28	1928-29
Sulphur Dyes	8,263	9,129
Nitrogen Dyes	2,247	3,045

In the first half of 1929-30 the output amounted to 9,051 tons, and the output of semi-manufactures during the same period amounted to 6,675 tons.

Coal tar products are being manufactured at 17 works, 16 of which are controlled by the Koksobenzol Trust and one by the Sibugol Trust. The value of the output of the Koksobenzol Trust amounts to 33,240,000 roubles, and that the Sibugol Trust to 2,100,000 roubles. The coal supplied to the Koksobenzol Trust in 1927-28 was 3,615,000 tons, and in 1928-29 4,409,000 tons. The following table shows the production of coal tar products in tons :

	1927-28	1928-29
Coal Tar	88,022	106,955
Liquid Ammonia	4,049	5,345
Crude Benzole	21,164	30,775

In the first half of 1929-30 the production of crude benzole reached 17,000 tons.

The Soviet Union exports coal, tar, pitch, solvent naphtha and naphthalene.

There are great prospects for the wood distillation industry in the Soviet Union, considering that the country possesses practically inexhaustible timber resources. The development of the wood distillation industry has, however, been retarded owing to the existence of a large number of small enterprises which used antiquated methods of production. This industry has now been re-organised and placed on a solid foundation by the cencentration and rationalisation of production, particularly that of charcoal, which is now manufactured in large quantities for the Ural metallurgical industry. In the production of charcoal the obtaining of a number of by-products is now to be introduced. A large increase in the production of resin and turpentine is anticipated in the Urals.

The following table shows the output of the wood distillation and turpentine-resin inrustries in tons :—

	1927-27	1928-29
Acetic Acid 30%	5,845	5,855
Acetic Acid 80	1,809	2,746
Methylated Spirit	957	—
Acetone, Crude and Refined	312	416
Formalin	682	1,299
Resin	2,129	5,706

This branch of the chemical industry is controlled by the Lakokraska Trust in Moscow and the Lenkhimtrust in Leningrad, which are engaged in the production of various lead and zinc paints, coloured paints, lithopone, ultramarine, etc., as well as varnish and drying oil. In addition to these large State factories there is a considerable number of small enterprises which principally produce the cheaper kind of paints.

The following table shows the output of paint and varnish in tons :—

	1927-28	1928-29
White Lead Paint	4,012	2,680
White Zinc Paint	7,425	9,665
Red Lead Paint	1,673	2,103
Ultramarine	2,345	3,472
Varnish	4,906	6,025

The paint and varnish industry not only satisfies the demand of the home market, but exports considerable quantities abroad, where the Rnssian products are in good demand. The trusts are developing the production of synthetic tar and nitro-cellulose varnishes in order to avaid the necessity of importing raw materials.

JOHANNESBURG ELECTRICITY SUPPLY.

The Electricity Supply Commission of Johannesburg have just placed an order for the supply of new boiler plant in connection with the installation of further electrical generating equipment at their Congella Power Station, Durban. The erection of this new station, in which the boiler plant is fired throughout with pulverised fuel, commenced in 1926 with the provision of four 60/80,000 lbs. B. and W. Boilers fired by the Lopulco system, and has recently been extended by the addition for the steam raising plant now found necessary has again been placed with International Combustion Limited, but the equipment selected in this case comprises two standard Combustion Steam Generators of 100/-120,000 lbs. per hour evaporation at 270 lbs. per sq. in. pressure and 70%F. final temperature complete with Lopulco Pulverised Fuel Firing Equipment.

It is interesting to note that this is the fifth contract for puverised fuel fired boiler plant by International Combustion Ltd. in South Africa this year and their fourth order for Combustion Steam Generators, eight of which are now under construction in addition to those already installed in British power stations.

GENERAL NOTES

BOARD OF TRADE ANNOUNCEMENT.

Exemptions from Key Industry Duty.

The Treasury have made an Order under Section 10(5) of the Finance Act, 1926, continuing the exemption from duty of the following articles till 31 December, 1931 :—

Acid adipinic; acid lactic which satisfies the requirements of the British Pharmacopœia; acid oxalic; amidopyrin (pyramidon; dimethyl-amidoantipyrine); ammonium perchlorate; barbitone (veronal; malonal; malourea; acid diethyl barbituric, diethylmalonylurea; hypnogen, deba); bromural (dormogene); celtium oxide; chinosol; cocaine, crude; dial (acid diallyl barbituric); dicyandiamide; didial (ethyl morphine diallyl barbiturate); dysprosium oxide, elbon (cinnamoyl para oxyphenyl urea); erbium oxide; ethylene bromide; eukodal; europium oxide; furfurol; gadolinium oxide; glycol ethers; guaiacol carbonate (duotal); holmium oxide; hydroquinone; integrators (planimeter type); R. lead acetate; lead tetraethyl; lipoiodin; lutecium oxide; mercury vapour rectifiers having mercury cathodes; metaldehyde; methyl cyclohexanol methyl adipate; methyl sulphonal (diethylsulphonemethylethylmethane, trional); neodymium oxide; nickel hydroxide; oxymethyl paraoxyphenyl benzylamine methyl sulphate; papaverine; phenacetin (acetparaphenetidine); phenazone (antipyrine; phenyl dimethylpyrazolone; analgesin; anodynine; dimethyl oxychinizin); phenetidine, para-; phytin; piperazine (diethylene-diamine; dispermin); planimeters; S. Potassium chlorate; potassium ethylxanthogenate (potassium xanthogenate); potassium guaiacol sulphonate (thiocol); R. potassium hydroxide (R. potassium caustic; R. potassium hydrate); R. potassium permanganate; praseodymium oxide; pyramidon-veronal; quinine ethyl-carbonate; radium compounds; resorcine (resorcinol); salol (phenyl salicylate); samarium oxide; styracol (guaiacol cinnamate); sulphonal; synthalin; terbium oxide; thulium oxide; urea (carbamide); vanadium-silica compounds specially prepared for use as catalysts for sulphuric acid manufacture; ytterbium oxide; yttrium oxide.

The Treasury Order will shortly be published by the Stationery Office.

NO RENEWAL OF DYESTUFFS ACT.

At their meeting last week the Council of the Association of British Chemical Manufactures passed the following resolution directing attention to the extraordinary difficult situation in which the dyestuffs industry of this country is placeed through the failure of the Government to make any pronouncement on their policy concerning the Dyestuffs (Import Regulation) Act, due to expire on 15th January, 1931 :—

"That the Couneil of the A.B.C.M. views with regret the delay on the part of His Majesty's Government in announcing their policy with reference to the continuance or otherwise of the Dyestuffs Act. The Council desires to point out that only eight weeks remain before the expiration of the Act, and if it be not renewed, this time is quite insufficient for British Dyemakers to make arrangements to meet the adverse circumstances in which the industry will have to be connected."

The dyemaking industry born originally in this country, but allowed by apathetic British policy to become virtually a monoply of Germany has now been re-established to such an *extent that no less than 93% of the British requirements of dye stuffs are being made here, as compared with less than 20% pre-war.* This enormous progress, which has not only benefited the dyemakers and dye users, but which is a great national asset, has been rendered possible by the regulation of imports of foreign dyestuffs under the Dyestuffs Act.

H.M. Government announeed on November 20, that it had been decided to allow the Act to expire. This is regarded as most regrettable by the chemical industry in general.

DISTRIBUTION OF OUR OVERSEAS TRADE.

Imports into the United Kingdom from other British sources during the first nine months of 1930 amounted in value to 25.98 per cent. of the total from all countries, as compared with 26.79 per cent. in the corresponding period for 39.73 per cent. of all shipments, as against 40.91 per cent. Trade with Europe showed a substantial percentage increase in which most of the principal countries shared.

NEW STEAM-ELECTRIC PLANT IN NEW BRUNSWICK.

The New Brunswick Power Commission has recently awarded a dozen contracts for various items of equipment needed in the erection of a new steam-electric power generating station at Newcastle Creek, on Grand Lake, in the Minto coal field. The erection of a pit-mouth was authorised some months ago by the Provincial Government and construction is now well advanced. The total cost of the project would be in the neighbourhood of £160,000. The modern steam turbine plant will use pulverised coal for fuel, and the generators will deliver approximately 5,000 kilowatts. Two 2,500 kilowatt steam-turbine generator units are to be installed, and the current will be distributed for industrial and other uses in York, Sunbury and Queens Counties.

The new generating station will serve a large area containing the mast thickly populated portion of the Province . The Minto coal area is stated to contain bituminous coal resources estimated at about 70,000,000 tons. A railway spur of about one and a half miles is being built into the power plant from the Canadian Pacific railway line near Minto station.

OUR OVERSEAS TRADE IN OCTOBER.

While the seasonal increase in the value of imports in October over that for September was about £12.2 million, as against an average of £10.2 million for the preceding three years, a corresponding improvement was not shown in exports, the seasonal increase in which amounted to only £4.2 million, or appreciably less than the average increase for the three previous years.

BRITISH EMIGRATION AND IMMIGRATION.

British subjects emigrating from the United Kingdom during the first nine months of 1930 numbered 77,691, as compared with 113,962 in the corresponding period of last year. British immigrants into the country totalled 50,539, as against 43,619. The net excess of emigration over immigration fell, therefore, to 27,152 from 70,343.

WHOLESALE PRICES IN OCTOBER.

A decline of 2.2 per cent. is shown as compared with September, and a fall of 17.0 per cent. as against October as last year, the respective index nubers being 68.0, 69.5 and 81.9 Food prices showed some tendency to [illegible] towards the end of the month.

Proceedings and Notices of Societies

THE ROYAL SOCIETY.

Thursday, November 20.

The following papers were read :—

Iridescent Colours of Birds and Insects. By LORD RAYLEIGH, F.R.S.

The reflexion spectra of various brilliantly coloured insects are examined in the ultra-violet. *Morpho* butterflies and Urania moths are found to show ultra-violet maxima in general agreement with the theory of interference. In *Morpho achilles* the positions of the ultra-violet maxima indicate that the blue colour is due to a reflexion of the secondary order. Spectra are reproduced.

Contrary to some previous accounts, no *Morpho* butterflies are found to show their blue colour by transmission. They do show brilliant diffraction spectra by transmission, when suitably mounted in balsam, but these have nothing to do with the blue reflexion.

Iridescent beetles showing a deep red colour at normal incidence may be made to pass through all the colours of the spectrum to violet, provided that arrangements are made to annul refraction at the air-chitin surface so as to obtain very oblique incidence withont. This is in sharp contrast to the surface reflexion of aniline dyes, which do not show much change of colour with incidence.

Some of the golden beetles show transmission spectra of bands corresponding to the reflexion spectra formerly described. These bands vary continuously in position with the part of the specimen examined. It seems impossible to interpret this reasonably except on the theory of interference. The transmission bands of chemical substances do not vary from one sample to another. The spectra are reproduced.

Moist chlorine gas does not destroy the colours of *Morpho* or of *Urania*, though the black background is bleached. Nor does chlorine decolourise the metallic beetles. The colours of all kinds of feathers, however, are rapidly discharged.

Peacock feathers undergo a progressive change of colour in ultra-violet light or long-continued sunlight. Generally speaking, the colours become more refrangible.

Other feathers (*e.g.* parrot) even when blue are slowly decolourised without change of refrangibility. *Morpho* butterflies and *Urania* also lose colour without change of refrangibility.

Although, *prima facie*, facing under light or chlorine in these cases would seem to favour the idea of a pigment, it is not considered that this view can be maintained. The fading must rather be attributed to the breaking down of an interference structure. It remains unexplained why the progressive change of tint seen in peacock feathers are not seen in the other cases examined.

The generalisation seems to hold good, however, that colour which is stable in chlorine is certainly *not* due to pigments.

Investigations in the Infra-Red Region of the Spectrum.—I, II. By C. R. Bailey, A. B. D. Cassie, and W. R. Angus. Communicated by F. G. Donnan, F.R.S.

In Part I the technique and the possibilities of experimental error are discussed.

Part II deals with the absorption spectrum of sulphur dioxide :—

The infra-red absorption spectrum of sulphur dioxide has been re-examined in the region 1 to 22μ with a prism spectrometer fitted with quartz, fluorite, rocksalt, and sylvine prisms.

The spectrometer having been carefully calibrated and allowance made for the change in dispersion of the prism materials with temperature, it is believed that the results are generally accurate to $\pm 0.003\mu$.

The ascertained spectrum has been compared with the previous work of Coblentz.

The partial resolution effected in most of the bands has rendered possible the determination of a number of the molecular constants, in particular the size and shape of the molecule, the moments of inertia, and the fundamental vibrational frequencies.

The observed infra-red spectrum has been co-ordinated with the Raman spectrum of the liquid.

The Exchange of Energy Between Gas Atoms and Solid Surfaces. By J. K. Roberts. Communicated by Sir Ernest Rutherford, P.R.S.

Experiments on the accommodation coefficients of helium with tungsten and nickel surfaces have been carried out under conditions in which the surfaces could be freed from films of adsorbed gas and kept free long enough to obtain measurements for clean surfaces. The values obtained were 0.05 to 0.07 for tungsten and 0.08 for nickel, and are considerably lower than the values ordinarily obtained or gas covered surfaces (Soddy and Berry 0.3).

The results are discussed from the point of view of the reflection and diffraction of molecules and from that of the classical collision theory.

Papers read in title only :—

The Application of Osborne Reynold's Theory of Heat Transfer to Flow Through a Pipe. By G. I. Taylor, F.R.S.

Observations on the Amount of Ozone in the Earth s Atmosphere and its Relation to other Geophysical Conditions.—IV. By G. M. B. Dobson, F.R.S., H. H. Kimball and E. Kidson.

Spectrometric Determinations of the Effect of a Neutral Salt on the Dissociation of Acetic Acid. By N. V. Sidgwick, F.R.S., and L. A. Woodward.

Colorimetric Investigations of Indicators in Presence of Neutral Salts. By N. V. Sidgwick, F.R.S., W. J. Worboys and L. A. Woodward.

Absolute Intensity of the Aurora Line in the Night Sky and the Number of Atomic Transitions Required to Maintain It. By Lord Rayleigh, F.R.S.

The Use of Series of Bessel Functions in Problems Connected with Cylindrical Wind Tunnels. By G. N. Watson, F.R.S.

On Optical Pyrometry. By A. C. Egerton, F.R.S., and M. Milford.

The Sorption of Water Vapour at Low Pressures by Activated Charcoals. Part I. By A. J. Allmand, F.R.S., and R. B. King.

By a slight modification of methods already described, the isothermals of water vapour have been determined for six different and typical activated charcoal specimens, at 25° C. and over a pressure range of 10^{-1} down to 10^{-3} mm.

Evidence was obtained that the presence of undisplaced gases on the charcoal surface are the cause of "drift," as in other cases. When this displacement had proceeded to its limit under the experimental conditions, the isothermals were apparently reversible. No sign of the validity of "Henry's Law" was observed.

It is thought that water vapour is relatively ineffective as a displacing agent for adsorbed oxygen, which would account for the comparatively small quantities taken up by the charcoal as compared with the amounts sorbed when higher initial charging pressures are used.

Indications were found that the heat of adsorption increases as the quantity sorbed decreases. No definite evidence of discontinuity in the isothermals was discovered.

THE GEOLOGICAL SOCIETY OF LONDON.

November 5, 1930.

Prof. E. J. Garwood, M.A., Sc.D., F.R.S., President, in the chair.

Prof. Paul Lemoine, Paris; and Prof. Gustaaf Adolf Frederik Molengraaff, Delft, were elected Foreign Members of the Society.

Prof. Ray Smith Bassler, Washington (D.C.); Prof. Otto Mügge, Göttingen; Dr. Dimitriev Ivanovich Mushketov, Leningrad; Madame Marie Pavlov, Moscow; Prof. Percy D. Quensel, Stockholm; and Prof. Eric Stensiö, Stockholm, were elected Foreign Correspondents of the Society.

The following communications were read:

The Geology of the Dolwyddelan Syncline (North Wales). By Howell Williams, M.A., D.Sc., D.I.C., F.G.S., and Oliver Meredith Boone Bulman, Ph.D., D.I.C., A.R.C.Sc., F.G.S.

The graptolite fauna of the Black Slates furnishes an upper time-limit for the Snowdonian vulcanicity, and this may be assigned to the upper part of the Zone of *Dicranograptus clingani*. Rather less certain is the evidence for the age of the upper Glanrafon Beds which underlie the volcanic series, but it cannot be placed much below the Middle Caradocian. Possibly, therefore, the Snowdon lavas and tuffs correspond to no more than the lower part of the *Dicranograptus-clingani Zone*, but the necessity of collating shelly and graptolitic faunas introduces some uncertainty.

The central portion of the northern limb of the syncline has been overturned, much as has the northern limb of the Snowdon Syncline, and in both cases the cleavage-dip diminishes in the zone of inversion from the normal regional angle of 70°-80° to one of 30°-40°. West of the area of maximum inversion, there is evidence, in the subsidiary lava-syncline of Afon Diwaunedd, of small-scale isoclinal folding, such as might precede the development of imbricate structure, but in the syncline itself there is no indication of such folding, neither is there any indication of large-scale thrusting. The field-evidence, however, suggests the occurrence of a multiplicity of glide-planes, mostly coinciding with the planes of cleavage. The Authors incline to the view that the overturning of the northern limb was accomplished by a kind of 'underdrive,' much of which took place prior to and during the impression of cleavage, but the final stages of which seem to have been part of a general post-cleavage movement.

Large bodies of fresh augite-dolerite, well developed along the northern limb of the syncline, testify to the post-cleavage intrusion of basic magmas.

Jointing in the Great Scar Limestone of Craven and its Relation to the Tectonics of the Area. By Lawrence Rickard Wager, F.G.S.

The Great Scar Limestone of Craven is traversed by two sets of nearly vertical joints, which are usually at right angles one to the other. Some 4 miles north-west of Grassington-in-Wharfdale, the lead-veins run parallel to one set of the joints, and were in fact deposited in widened joints. The joints and mineral veins are constant in direction over a considerable area; but, as the North Craven Fault is approached, their direction is modified. These preliminary observations showed that the formation of the joints preceded the mineralisation, which is probably of pre-Permian age, and suggested that the jointing and the Craven Faults may be related in some way, since the modification in the direction of the joints is localised near the faults.

In order to test this hypothesis, the joints have been examined over a wide area, and a map has been made showing the direction of the jointing in the Great Scar Limestone between Dentdale and Wensleydale and the Dent and Craven Faults. The character of individual joint-planes and of the joint-pattern is considered to indicate that the normal joints were formed, as shearing fractures, at approximately 45° to a maximum horizontal compressive stress in the Earth's crust.

Specimens and lantern-slides were exhibited by Dr. O. M. B. Bulman, in illustration of his and Dr. Williams' paper; and diagrams and photographs were exhibited by Prof. H. L. Hawkins, in illustration of Mr. L. R. Wager's paper.

The Officers exhibited the 1931 Wollaston Medal. This has been struck in palladium instead of gold, the metal having been presented by the Mond Nickel Company, Ltd. Wollaston was the discoverer of palladium, and his medal was struck in that metal from 1846 to 1860.

The Dartmoor Granites: Their Genetic Relationships (with 80 analyses by Dr. H. F. Harwood, and Assistants). By Alfred Brammall, Ph.D., M.Sc., D.I.SC., F.G.S.

THE OPTICAL SOCIETY.

A meeting of the members of the Optical Society was held at the Imperial College of Science and Technology, South Kensington, on Thursday, November 13, 1930; the President, Mr. F. Twyman, F.R.S., in the chair. The following demonstrations were given :—

The Use of the Spectrograph in Metallurgical Analysis. By D. M. SMITH, A.R.C.S., B.Sc., D.I.C., of the British Non-Ferrous Metals Research Association.

Spectrograms of specimens were taken and developed on the lecture table and the spectra projected as lantern slides.

A New Spectrophotometer. By H. BUCKLEY AND F. J. C. BROOKES, of the Photometry Department, National Physical Laboratory.

This was described as a new type of spectrophotometer in which there are no moving optical media. Two light sources consisting of gas-filled tungsten lamps each behind ground glass are used. The ground glasses are used as secondary light sources of high uniform brightness (up to 400 candles per square inch). The photometric scale of the instrument is in terms of the voltage intensity relation of one of the light sources at a standard wave-length in conjunction with rotating sector discs of known transmission. The voltage intensity relation at other wave-lengths is shown to be deducible from that at the standard wave-length by simple computation. Special provision is made whereby the wave-length of the instrument is not affected by mechanical alteration in slit width. The Maxwellian method of view is utilised. The precision of the instrument is high, the average deviation from the mean of determinations of spectral transmission throughout most of the spectrum being about 0.5 per cent.

THE INSTITUTION OF CIVIL ENGINEERS.

PRESIDENTIAL ADDRESS OF SIR GEORGE WILLIAM HUMPHREYS, K.B.E., *President.*

LONDON AND THE THAMES.

The President reviewed the activities of the premier municipal body of the Empire from his standpoint as Chief Engineer and Adminstrator of Housing of the London County Council—a body with which he had been associated for the past 28 years. During this period the population of Greater London had increased from 6,600.000 in 1901 to nearly 8,000,000 to-day, while that of the County had shown a slight but steady diminution. The problems which arose from this growth and redistribution of the population concerned both the administrator and the engineer in close relationship and were of wide interest to every Londoner. In describing what had been done in the past and what remained to be done the Address illustrated the dependence of administrative ordinances on the advice and counsel which the engineer alone could give.

London had expanded, and in effect now covered an area in which the limits of the County were indicated only by obscure boundary stones or marks and of which no outer limit existed or could even be foretold. The following Table illustrated the wide extent of the proncipal services.—

	Sq. Miles
London County contained	117
London main drainage area contained...	180
London water area contained ...	574
London telephone area contained...	735
London and home counties electricity area contained	1,797
London traffic area contained ...	1,820

The principal physical feature, cutting each of these areas in half, was the tidal estuary of the river Thames, mention of which recurred throughout the Address as introducing its special problem in connection with each of the engineering problems in London, and which was described as " a good servant but a bad master."

These problems included all the modern requirements of so large a community : adequate means of communication, whether by road, railways or water, water-supply and drainage, refuse collection and disposal, telephone and telegraph, electricity and gas, housing and town planning, all on a very extensive scale.

London drainage presented many remarkable features inherited from the days when it was discharged crude into the nearest stream, such as the Fleet, Westbourne, Tybourne or Wallbrook, or direct into the Thames itself. An important factor was that the contents of the tidal river throughout London could not reach the sea on an ebb tide, being met by the incoming tide after a passage of about 12 miles down the river. These conditions, the continual discharge of crude sewage and the tidal oscillations, in time had their effect until, in the early fifties of last century, the con-

dition of the Thames constituted a nuisance and the Metropolitan Board of Works was created to intercept London sewage and discharge it by artificial sewers to outfalls beyond London. After much controversy the outfalls were ultimately fixed at Barking and Crossness. At these outfalls the sewage was originally stored in tanks and discharged only on the ebb tide; since 1887, however, it had been sedimented in tanks and the sludge deposited at sea about 48 miles below Gravesend. This system had hitherto proved sufficient, though the increase in volume and consequent abstraction of oxygen from the river had directed attention to the necessity of obtaining a better effluent, and it was decided last year to instal at Barking an activated-sludge unit to treat a portion of the flow at that station, the construction of which was now proceeding.

The area surrounding the County within a radius of 25 miles of Charing Cross contained as many as 200 separate sewage-works, the effluents from which found their way to the tidal Thames, and the problem of making provision on a comprehensive system for these and additional areas within the catchment-area was now engaging the attention of the Ministry of Health.

To cope with the conditions which arose when very intense rainfalls occurred at about the time of high water, as also to provide for the large areas below high-water level, the County Council had carried out a scheme of storm-relief sewers and pumping-stations now nearly completed.

Public cleansing, which was under the separate control of the City and Borough Councils, had lately been examined by, and was now under the review of the Ministry of Health, and there was great scope for research work on the problem of how to dispose of the huge quantity of refuse economically and without nuisance.

The greater part of the water used in London was drawn from the river Thames, and the remainder from its tributary, the river Lee and from wells, by the Metropolitan Water Board, which was constituted in 1903. The Board had to-day available storage-reservoirs of a total capacity of 19,657 million gal., and despite some restriction of use in 1929, it successfully maintained a supply of about 100,000 million gal. of good water a year to a population of about 7½ millions.

Another *ad hoc* authority which literally lived upon the river Thames was the Port of London Authority, constituted in 1908. The capital expended since that date included £17,000,000 spent on improvements, the most notable of which were the King George V dock, the extensions at Tilbury, and alterations at the India and Millwall docks. In addition, systematic dredging of the river had been undertaken, and a channel 1,000 ft. wide, giving 30 ft. at low water, was being obtained from the Nore to Coldharbour Point. Cross-river tunnels exercised an influence on the depth, and for the proejcted new tunnel between Dartford and Purfleet, for which Parliamentary sanction was obtained last year, provision was made in the Act to permit of a channel over it having a depth of 50 ft. at low water.

A brief review of the bridges and later tunnels across the river concluded with reference to the completion, during the present century, of new bridges at Vauxhall and Southwark, a new bridge at Lambeth now in course of construction, and proposals for a new bridge opposite St. Paul's Cathedral. The failure of the foundations of Waterloo Bridge had given rise to the question of cross-river communications. This was the subject of a Royal Commission report in 1926 which adumbrated a large programme of bridge- and road-communications involving an expenditure of £27,500,000. Their recommendations included the construction of a road bridge at Charing Cross, and in the last session of Parliament the London County Council accordingly deposited a Bill for this purpose. The proposals, however, failed to find favour with the Select Committee of the House of Commons and the Bill was rejected. The Council had recently called together a Special Advisory Committee, whose findings on this difficult problem were now awaited with interest.

Two vehicular tunnels under the river at Blackwall and Rotherhithe and two tunnels for foot passengers at Greenwich and Woolwich had been constructed in recent years. The development of the internal-combustion engine had produced difficulties in the way of ventilation to a degree not comtemplated when the tunnels were made.

The Thames was confined between artificial banks, probably not less than 300 miles in length and dating from very early days. In South London alone, within the County there were over 20 sq. miles of densely populated area below the level of tides that had been experienced. Breaches

in the walls had occurred from time to time, and since the exceptionally high tide recorded by Pepys in 1663, which flooded Whitehall, very high tides have been recorded at intervals. The most recent occurred on the 7th January, 1928, when all previous records were broken and extensive flooding took place, accompanied, unhappily, by loss of life. After a careful inquiry into the causes and conditions, the London County Council was advised, and ordered, that the defence works should be raised above the previously prescribed height of 18 ft. O.D. throughout the County. There remained, however, the anomaly that for the stretch from the County boundary on the west up to Teddington no authority was responsible.

In the last session of Parliament a Land Drainage Act was passed creating new authorities for catchment-areas, the area in the case of the Thames being that draining to Teddington, so that the tidal part of the river was outside the purview of the authority. This instance emphasized the need for co-ordination, and a comprehensive survey of the whole of the river, tidal and non-tidal, by a hydraulic engineer was strongly advocated.

There were other services depending upon the work of the engineer in which public funds are concerned. The Government was responsible for the network of telephone and telegraph wires and cables, and possessed deep-level tubes for its postal service. The London and Home Counties Electricity area was only surpassed in size by the London Traffic area, and large developments were about to take place in the way of an increase of generating units and transmission facilities. The gas service, on the other hand, was entirely in the hands of private enterprise. The increase in numbers, speed, and weight of vehicles had increased the liability to fracture of both gas- and water-mains, and the advisability of placing gas-mains in subways had been questioned. A small leak of gas in such circumstances was capable of forming an explosive mixture, and, although no explosion had occurred in London in a subway containing gas-mains, opinion now inclined to the exclusion of gas-mains from subways, and the damage done in December, 1928, by the explosion at Holborn emphasized the necessity of the well-known precautions that should always be taken for free ventilation of all underground

It was amusing in these days of expansion to read the enactments of Queen Elizabeth in 1580 prohibiting the erection of any new buildings or houses within 3 miles of any of the gates of the City of London. Charles I added to the proclamations in 1625 and again in 1630. In the former of these he not only prescribed for bricks "so as for the assizes every bricke being burned contains in length nine inches in breadth foure inches one quarter and halfe of an inch and in thickness two inches and one quarter of an inch" but also laid down seasons for digging the clay and moulding, and went so far as to state that the price of bricks "shall not excede the rate of eight shillings the thousand at the Kilne." These proclamations were issued before the Great Fire of London and formed the first examples of a slum-clearance, or slum-prevention policy, as the fire originated the idea of town planning for London.

A Greater London Regional Planning Committee, constituted in 1927, issued its first report last December. The area under the Committee's review was the London Traffic area (1,820 sq. miles). In dealing with the framework of these large conceptions for the future there was scope for the best counsels of the expert and the administrator.

The last activity described in the Address was that of housing-accommodation for the working-classes. The contributions of the London County Council and the Borough Councils since the war amounted to about 40,000 and 11,000 dwellings respectively. The London County Council since 1920 had been able to create what were small town ships, namely :—

	Dwellings
In Lewisham Borough—Bellingham Estate	2,000
In Lewisham Borough—Downham Estate	6,000
At Hendon—Watling Estate ...	4,000
Near Morden—St. Helier Estate ...	10,000
Near Dagenham—Becontree Estate	25,000

The St. Helier estate was still under construction, and the figure for Becontree included 6,000 houses for which orders had now been given to the contractor.

The Address concluded with observations on the relationship between Policy as interpreted by the legislator and administrator, and Action, the special function of the engineer ; and pointed out that at present there appeared to be a waste and overlapping of effort as far as the labours

NOTICES OF BOOKS.

Quantum Chemistry. By Prof. A. Haas, Ph.D. Translated by L. W. Codd, M.A. Pp. x + 74. London: Messrs. Constable, Orange Street, W.C. 1930. Price 6s.

This brief work contains the substance of a series of special lectures delivered by Prof. Haas last year in Vienna and is an attempt to explain those principles of the Quantum Theory which are of the most significance, in terms that are clear and intelligible to chemists and without reference to mathematical formulæ.

The author begins with the arithmetic of chemical periodicity and then goes on to discuss the quantum theory of valency and chemical affinity and electron grouping and concludes with the problems of molecular and nuclear structure.

Forthcoming Events.

ROYAL SOCIETY OF ARTS.

John Street, Adelphi, W.C.2.

Monday, December 1, at 8 p.m.—(Cantor Lecture).—" Modern Domestic Scientific Appliances." (Lecture II.) By Prof. C. R. Darling, F.I.C., F.Inst.P.

THE PHYSICAL SOCIETY.

Friday, December 5, at 5 p.m., at the Imperial College of Science, Imperial Institute Road, South Kensington.—Ordinary Meeting.

ROYAL INSTITUTION OF GREAT BRITAIN.

21, Albemarle Street, W.1.

Tuesdays, December 2 and 9, at 5.15 p.m.—" Stellar Structure and the Origin of the Stellar Energy." By E. A. Milne, M.A., M.Mc., F.R.S.

Thursdays, December 4 and 11, at 5.15 p.m.—" The Agricultural Development of the Empire. (I) Reclaiming the Wastes. (II) Conquest of the Drought." By Sir John Russell, D.Sc., F.R.S.

THE INSTITUTE OF METALS.

Scottish Local Section.

Tuesday, December 2, at 7.30 p.m., in the Rooms of the Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank Crescent, Glasgow.—" Non-Ferrous Alloys used by Engineers." Paper will be read by Mr. W. Lambert. This will be a joint meeting with the Institution of Engineers and Shipbuilders in Scotland.

ROYAL INSTITUTE OF PUBLIC HEALTH.

Wednesday, December 3, at 4 p.m., in the Lecture Hall of the Institute, 37, Russell Square, W.C.1.—" The Prevention of Disorders and Disease in Tropical Countries." By Prof. D. B. Blacklock, M.D., D.P.H., D.T.M.

MANCHESTER SOCIETY OF CHEMICAL INDUSTRY.

Friday, December 5, at 7 p.m., in the Engineers' Club, 71, Albert Square, Manchester:—

(I) " The Estimation of Minute Traces of Copper." By Dr. T. Callan, M.Sc., F.I.C.

(II) " The Reaction of Formaldehyde Derivatives with Cellulose. The Formation of Mono-cellulose Methylene Ether." By Dr. F. C. Wood, M.Sc., F.I.C.

(III) " The Action of Grignard Reagent on Cellulose." By Dr. F. C. Wood, M.Sc., F.I.C.

(IV) " Some Notes on Viscose Dyeing." By C. M. Whittaker, B.Sc.

(V) " A Skin Effect on Viscose Rayon." By J. M. Preston, B.Sc., A.I.C.

INSTITUTE OF CHEMISTRY OF GREAT BRITAIN AND IRELAND.

Belfast and District Section.

Wednesday, December 3, at 7.30 p.m., in the Physics Lecture Theatre of the Royal Belfast Academical Institution.—Annual Dinner.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

33,022.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of aroyl-acetic-acid-arylides. November 3.

33,448.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of derivatives of a-a-a-tribromethane. November 6.

33,692.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of 1 : 7-dihydroxy-naphthalene. November 8.

Specifications Published.

312,349.—Krupp Akt.-Ges., F.—Manufacture of articles hardened by nitrogenisation.

337,406.—I. G. Farbenindustrie Akt.-Ges.—Manufacture and production of sulphuric acid and nitric acid.

337,368.—I. G. Farbenindustrie Akt.-Ges.—Process for the manufacture of fatty acid derivatives.

Abstract Published.

335,232.—Anthraquinone derivatives.—Smith, W., Primrose, J., Thomas, J., and Scottish Dyes, Ltd., Earl's Road, Grangemouth.

1-Chlor-2-methylanthraquinone; 1-chloranthraquinone-2-carboxylic acid.—1-Chlor-2-methylanthraquinone is obtained by chlorinating 2-methylanthraquinone in oleum of strength not exceeding about 20 per cent. at temperatures not exceeding 15° C. The process is especially useful as a step in the conversion of 4[1]-methyl-2-benzoylbenzoic acid into 1-chloranthraquinone-2-carboxylic acid without isolation of intermediate products, as described in Specification 207,840. In examples (1) 2-methylanthraquinone is chlorinated in weak oleum in the presence of iodine and (2) 4[1]-methyl-2-benzoylbenzoic acid is heated with oleum, cooled, a little iodine is added, and chlorine is passed through the solution at 0° C. The 1-chlor-2-methylanthraquinone may be isolated by pouring the solution into water, or by treating the solutions with oxidising agents, such as manganese dioxide, 1-chloranthraquinone-2-carboxylic acid may be obtained directly.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

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516,850.—All goods in class 1 which includes chemical substances used in manufactures, photography, philosophical research and anti-corrosives.

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BALL LIGHTNING AND NITROGEN PEROXIDE.

By F. H. LORING.

Professor R. W. Wood gives an account of globular or ball lightning in *Nature* (1930, *126*, 723) the gist of which is as follows:—A house was struck twice within 15 minutes, a chimney being shattered. Lightning flashes had approached the house in rapid succession and one person in the house was rendered unconscious for a short period; then another flash melted the telephone wires having followed their course into the cellar, while a 'ball discharge' appeared in the kitchen (over the cellar) in the middle of the room over the cellar furnace-pipes and about 3 feet from the floor and within about 3 feet of the cook who observed it as: *yellow, like a flame, about 5 inches in diameter and spinning like a top.* The cook ran from it, so did not see any explosion nor associate with it any sound, but reported that on returning to the room *the air was hazy and had a strong acid-like smell. No damage was done or marks noticed.*

Professor Wood suggests that the ball might have been composed of an *oxide of nitrogen.*

In the *Chemical News* (1929, *139*, 386) the present writer suggested NO_2 in view of the data there recorded; and a "whirl" was also fundamentally postulated.

This adds another piece of information to the subject, but it is unfortunate that Professor Wood was not the eye-witness in this case.

THE PRINCIPLE OF INDETERMINACY.

Sir James Jeans in his THE MYSTERIOUS UNIVERSE (1930)—15,000 sold in one week, which breaks the record especially for a scientific book—gives a neat definition of the principle of indeterminacy (p. 26);—It is as though the position and motion of the electron had been marked on the two different faces of a lantern slide. If we put the slide in a bad lantern, we can focus half-way between the two faces, and shall see both the position and motion of the electron tolerably clearly. With a perfect lantern, we could not do this; the more we focussed on one, the more blurred the other would become. The imperfect lantern is the old science . . . But now that we have the more perfect lantern in the new science, it merely shows us that the specifications of position and motion lie in two different planes of reality, which cannot be brought simultaneously into sharp focus. In so doing, it cuts away the ground on which the old determinism was based.

Jeans says more on the subject, but the book (price 3s. 6d.) should be purchased by everybody interested in science at all as it covers a wide range and is written in a simple straightforward style.

See *Chemical News* (1930, *140*, 259-260) for a discussion of the above and Pauli's exclusion principle.

Good companion books are:—Jeans: THE UNIVERSE AROUND US (2nd Edn., 1930). Smart:—THE SUN, THE STARS AND THE UNIVERSE (1928).

F. H. L.

RATIONALIZATION.

By L. M. Angus-Butterworth, F.R.G.S. F.Z.S., F.S.A. Scot.

Two equally unpleasant facts make it imperative that we should consider afresh the whole structure of industry in this country. There is first the unparalleled depression in trade, constituting in itself a national problem of the utmost gravity, and second there is the widespread conviction that our competitors overseas are not suffering so greatly as ourselves, and in many cases are, on the contrary, making extremely rapid industrial progress. The new term rationalization has come into use to express the present-day efforts to re-organize industry.

The word rationalization originated in Germany in connection with the reconstruction of her basic industries after the period of inflation and the French occupation. As in other European countries an excess of productive capacity had been created during the war, and, when demand shrank, production was "rationed" among the various works in each industry under the quota arrangements which the old-established syndicates and cartels had brought into operation. Later schemes of reconstruction were closely associated in the minds of the German industrialists with this system of rationing, and the term rationalization continued to be used when the principle it described had been extended in meaning beyond recognition.

The definition of rationalization given by the German Federation of Industries in 1925 was in these words, "It is the employment of all methods of technique and organisation in order to increase the productivity of the workers to the highest possible degree and, as a result, to improve, increase and cheapen production." Elsewhere it has been refined as, "the amalgamation of firms doing a similar class of business with the object of securing greater efficiency and economy in production." A third somewhat different description that has been given is "the technical, commercial and financial organisation of an industry in such manner that the cost of manufacture of the products of the industry can be reduced to the lowest possible level without adversely affecting the conditions of employment of those in the industry."

The careful and comprehensive definition given by the World Economic Conference at Geneva in 1927 was, "the methods of technique and organisation designed to secure the minimum waste of either effort or material. It includes the scientific organisation of labour, standardisation both of material and products, simplification of processes and improvements in the system of transport and marketing."

Perhaps the best definition of rationalization that has yet been formulated is that of Sir Mark Webster Jenkinson, who is well-known in the British heavy steel trades. Sir Mark declares that, "rationalization is the mobilization of the fighting forces of an industry. . . . It is accomplished by the fusion of manufacturing capacity and the closing down of redundant units to eliminate waste and loss, production being concentrated in the best-equipped shops, under the most favourable output conditions. It implies not merely a reconstruction of capital, a reorganisation of management, a reshuffling of plant, but a revolution in our ideas, in our mentality, in our outlook on the industrial situation."

Rationalization is probably the best evidence we have of a new breadth of outlook in our generation. Before the war it seems to have been possible for the small unit in almost any industry to go its own way with very little knowledge of what its competitors were doing. It would not be untrue to say that most of our industries were blighted by a stupid and conservative individualism, which still persists to some extent. A product would be made in a large number of small factories, witr poor equipment and by rule-of-thumb methods. It would seem that the average manufacturer was only vaguely aware of the existence of anyone in the same line of business as himself.

During the war a new "world-sense" appears to have been developed. The war made it necessary for producers to change their old habits of secrecy and animosity, and to co-operate not only on a national but on an international scale, and when hostilities were over the lesson was not forgotten. Even the man in the street became well-informed about the world sources of various raw materials and the corresponding manufactured commodities. It was therefore perhaps natural that the more important industries should realize themselves as a whole, and that for the first time they should become conscious of their corporate existence. Mutual aid and working together in larger units was found to be a very paying proposition, and rationalization is essentially the endeavour to get the utmost

out of this kind of co-operation in industry. In science it has always been the rule that knowledge should be pooled. Rationalization represents the application of this principle in industrial circles. The fierceness of present-day competition has made it necessary that only the very best methods of manufacture should be employed, and to secure this being brought about it has been unavoidable that there should be a general joining-up of the smaller and less efficient units in any particular industry.

The application of rationalization has varied greatly in different cases, but the main lines upon which it works are now fairly well defined and understood. It generally implies the reorganisation in turn of the administrative, productive and selling sides of an industry. Under the heading administration there has to be considered the questions of control, general policy, and finance; under production those of new plant, concentration of manufacture, standardisation of processes and products, etc.; and under sales those of development existing markets, creating a demand for new products, etc.

It will be evident that rationalization must usually cause amalgamation, almost always of firms all engaged in the same industry, but how far the process should be carried will depend upon circumstances. In most instances amalgamations under schemes of rationalization have been upon a functional or a geographical basis.

It is only possible to consider very briefly the manner in which rationalization is put into operation. When a group of firms decide to join forces under this system the object in view is to obtain greater efficiency and economy in production. The aim should not be to form a price-ring against the consumer. In this important respect rationalization differs fundamentally from the old type of price-fixing cartel, which often bolstered up inefficiency and maintained excessive prices in giving some profit even to its weakest member.

It would be a mistake to regard rationalization as something pleasant. It may be likened rather to a medicine of extreme nastiness, which the patient will only consent to take when any other means of recovery seem very remote. In the first place the individual firms joining together to form one large corporation can afterwards be controlled by a single board of directors. Thus many members of the boards of the former smaller units will no longer be required, and in the same way a proportion of the staff through all grades will be found to be redundant. The great saving here is in management expenses. To quote a concrete example, the Vereinigte Stahlwerke of Germany, which controls over 50 per cent. of the German steel production, state that in two and a half years rationalization has brought about the following changes in the number of their employees :—

1) Workmen, 4.8 per cent. increase.
2) Clerks, 2 per cent. decrease.
3) Commercial Staff, 18.5 per cent. decrease.
4) Management Staff, 26.6 per cent. decrease.

The financial aspect of rationalization is also one which calls for much sacrifice, this time on the part of the shareholders. Nominal values of shares cease to exist, and securities that have already been marked down to a low level on the Stock Exchange are found to be worth still less when earning power alone is accepted as the only true measure of value. The advantages springing from rationalization on the financial side include the power to make adequate provision for research and development, and for the constant replacement and improvement of plant. In addition there is usually a substantial economy possible in that the combined organisation need only keep much smaller liquid assets than the total of the cash balances that it was necessary for the separate undertakings to maintain. A further consideration which is largely financial is that a powerful corporation can resort to litigation to protect its interests and patents from foreign rivals, whereas a small concern might find the expense too great even if it felt confident about the issue. The public will more readily provide fresh capital for a rationalized industry, in which assets have been fully written down, than it will for individual firms.

When the new board has taken control, and finance has been arranged, an early and important step is to re-arrange the production of the factories in the group. The older and least efficient plants are closed down, and work is concentrated in those most up-to-date. Instead of each factory making a range of products specialisation is introduced, and there is allocated to each works the manufactures for which it is best suited.

Many people find a difficulty in understanding the necessity for closing down factories under rationalization. The root idea of this is that over the whole world, except

perhaps in America, productive capacity in the large basic industries has increased much in excess of consumptive capacity. In the case of Great Britain we have suffered more than other countries because of our greater industrial development during the 19th century. Our position, however, differs only in degree from that of other nations. We know that in Lancashire our cotton mills are capable of producing vastly more than they have had the opportunity of doing in recent wears, and with the mills that have been built in India, Japan, and elsewhere it is highly improbable that all our mills could ever work to full capacity again. The only sensible course would therefore to be to adopt some scheme of rationalisation, and this has in fact been introduced, as we are aware, by the Lancashire Cotton Corporation.

In the ship building industry our merchant tonnage under construction in the three years 1911-13 averaged 1,758,000 tons. The average for the three years 1923-25 was only 1,208,000 tons, from which point there was a slow recovery to the three years 1927-29, averaging 1,313,000 tons. But the capacity of our ship-yards is now considerably greater than it was before the war, it being calculated that in 1929 only about half the available berths were occupied. It is claimed in the industry itself that if consumption were to be expended to correspond to capacity, an output of approaching 3,000,000 tons per annum would be required. Here again it is clear that the capacity for production has overtaken and gone far beyond the demand, and, as in the case of the cotton trade, serious readjustment is essential. We all hope of course, that present conditions are not normal, and that if we ourselves do not live to see a recovery in trade our grandchildren may do. Presumably as the world grows richer more products will be created, and more ships will be required to carry them from place to place. The habit of travel, also, is no doubt one which will continue to grow rapidly among all classes of the community. But in the meantime it would be merely suicidal for the shipbuilding industry to maintain an enormous superfluous capacity, for not only would the immediate expense be crippling and increase the cost of our vessels, but when the new demand came it might be for something our existing yards are quite unsuited to supply. The proposal of rationalization is that ofter the industry had put its house in order it should expand gradually on whatever lines were required to meet new conditions.

The steel industry is similar to cotton and shipbuilding in that the world supply has now overtaken the demand. The world consumption of steel is still expanding, but more slowly than formerly. Manufacturing capacity, on the other hand, continues to grow exceedingly rapidly. The position has already become so serious that when the domestic steel syndicates were renewed recently in Germany it was decided that no member should undertake any extension of plant without consent of all other members. We ourselves have been harder hit than any other nation. Thus in the 16 years from 1913 to 1929 the steel industries of Germany, France, Belgium, the Saar and Luxemburg have increased their production by 40 per cent., while our increase has been only 26 per cent. During the same period the countries mentioned have increased their exports of steel products by over 5½ million tons per annum, while our steel exports show a small decrease. But even more significant is the fact that although the British steel output for 1929 amounted to a record weight of nearly 10 million tons, it was still only about 70 per cent. of our productive capacity. It is always possible that our competitors may retire from business, and that all our old steel works may again be busy. But with conditions as they are, and seem likely to remain, the only wise policy for the steel industry is the adopting of rationalization.

To be continued.

IRON AND STEEL PRODUCTION IN OCTOBER.

The National Federation of Iron and Steel Manufacturers reports that 415,000 tons of pig iron were produced in October, as compared with 425,000 tons in September, 688,700 tons in October, 1929, and a monthly average of 855,000 tons in 1913.

Furnaces in blast at the end of October numbered 96, a decrease of 8 as compared with the beginning of the month.

The October output of pig iron included 122,200 tons of hematite, 155,800 tons of basic, 105,000 tons of foundry and 21,200 tons of forge pig iron.

The production of steel ingots and castings in October amounted to 512,500 tons, compared with 580,600 tons in September, 889,800 tons in October, 1929, and a monthly average of 638,600 tons in 1913.

EFFECT OF CARBOHYDRATES AND OTHER IMPURITIES ON THE CRYSTALLISATION OF GLUTAMIC ACID HYDROCHLORIDE FROM DECOMPOSITION PRODUCTS OF SOY BEAN PROTEIN.

By MINORU MASHINO AND TADAO SHISHIDO.

It has been reported by Mashino that methanol has an ability to extract some kind of carbohydrate and impurities which have an unpleasant odour, colour and taste from soy bean cake.

The authors have studied on the influence of the methanol extractive matter upon the yield of glutamic acid hydrochloride in the course of the crystallisation of the latter from the decomposed product of soy bean cake.

The experiment was carried out as that an amount of methanol extract was added to glutamic acid hydrochloride, and glutamic acid hydrochloride was crystallised by ordinary method.

The yield of the crystal was diminished by the addition of the increasing amount of methanol extract, as shown in Table I.

TABLE I.

Methanol extract	Ratio of glutamic acid to extract	% of crystal glutamic acid
0 gr.	0	75.06
0.5 ,,	0.109	74.04
2.5 ,,	0.54	71.34
6 ,,	1.30	62.55
7.5 ,,	1.63	59.08
8.5 ,,	1.85	39.21

This phenomenon should be one of the important reasons why soy bean oil cake has not been utilised generally to manufacture glutaminate, notwithstanding the cake contains 40-45 per cent. of protein in which as much as 20 per cent. of glutamic acid are contained.

Using the soy bean oil cake purified with methanol beforehand of the decomposition process, they actually proved that a yield of 96 per cent. of glutamic acid hydrochloride can be obtained, while only a small quantity of the crystal was obtained from the unpurified cake.

Also, the effect of carbohydrates, formerly decomposed by hydrochloric acid, on the crystallisation of glutamic acid hydrochloride has been studied, the results of the experiments are shown in Table II.

TABLE II.

Effect of Decomposition product of carbohydrates on the crystallisation of glutamic acid hydrochloride.

Carbohydrates decomposed by HCl	% crystal glutamic acid HCl
None	75.06
Glucose	60.43
Fructose	62.70
Sucrose	48.85
Starch	61.40
Methanol extract	39.21

Further, the effect of carbohydrates on crystallisation of glutamic acid hydrochloride was studied. The results of the experiments are shown in Tahle III.

TABLE III.

Effect of carbohydrates on the crystallisation of glutamic acid hydrochloride.

	% Crystal glutamic acid HCl
None	75.24
Glucose	36.51
Fructose	54.45
Sucrose	38.58
Starch	44.94
Methanol extract	19.97

The diminishing effect of methanol extract on the yield of glutamic acid hydrochloride is greater than that of carbohydrates.—*The Tokyo Imperial Industrial Research Institute, Yoyohata, near Tokyo.*

A NEW MAGNETO-OPTIC METHOD OF CHEMICAL ANALYSIS—EKA-CÆSIUM.

F. Allison and E. J. Murphy give in a recent issue of *The Journal of the American Chemical Society* (1930, 52, 3796-3806) a new method of analysis as indicated by the title above.

A large number of measurements of various compounds are recorded and in many cases the orderly variations per compound correspond with the isotopes of the metal forming a constituent of the compound, so that the number of isotopes can be ascertained.

With regard to the identification of a new element by this method, which seems to be extraordinarily sensitive, these authors say: "Our recently reported evidence (*Phys. Rev.*, 1930, *35*, 285; [*Chem. News*, 1930, *140*, 283]) of the presence of element 87 [eka-cæsium] in certain samples of pollucite and lepiodolite ores is based upon the location of minima characteristic of an element of atomic weight and valence ascribed to eka-cæsium. An additional report of this investigations is contemplated in the near future."—P. 3805.

F. H. L.

SEVENTY YEARS AGO.

(From the Chemical News, Feb. 11, 1860)

On the Chemical Polarisation of Neutral Oxygen which takes place with the slow combustion of Phosphorus, by C. F. SCHÖNBEIN.

The author first describes the behaviour of a mixture of aqueous phosphorous acid and peroxide of hydrogen. This mixture has the following reactions:—

1. A dilute solution of chromic acid containing only one per cent. of the acid, is first coloured blue by the mixture; but ordinary oxygen is soon developed, and the solution becomes permanently green in consequence of the formation of a salt of chrome oxide. Diluted phosphorous acid will not alone reduce the free chromic acid, because from a mixture of two acid solutions no oxygen can be set free.

2. The mixture instantaneously decolorises a solution of permanganic acid or permanganate of potash with the rapid development of ordinary oxygen and the formation of a salt of manganous oxide. It is true that pure diluted phosphorous acid will also reduce permanganic acid to manganous oxide, but slowly, and naturally without setting free oxygen gas.

3. With peroxide of lead the mixture develops ordinary oxygen in the formation of a salt of protoxide of lead.

4. The mixture when added to water will not by itself colour blue a dilute solution of iodide of potassium and starch (the concentrated mixture will do so); but on the addition of a few drops of a dilute solution of sulphate of iron the starch mixture is instantaneously coloured blue.

5. At the ordinary temperature the mixture will slowly decolorise a moderately strong solution of indigo; bnt on adding a few drops of sulphate of iron solution it is instantly decolorised.

6. The mixture may be kept at a temperature of 212° Fahr. for some hours without losing the power of turning the solution of iodide of potassium and starch blue, with the co-operation of the dilute sulphate of iron solution.

7. Platinum black placed in contact with the mixture occasions no perceptible development of oxygen gas; but by continued agitation of the metallic powder with the liquid, the power of turning the iodide of potassium paste blue is completely lost.

8. The mixture may remain for days in contact with finely divided phosphorus without losing the property of colouring the iodide of potassium paste blue; but by standing together a longer time the power is lost.

GENERAL NOTES

MINERAL PRODUCTION IN CANADA.

FURTHER INCREASED OUTPUTS IN AUGUST.

Copper production in Canada during August amounted to 26,088,577 pounds, a slight decrease from the July total but an advance of 22.6 per cent. over the output in August, 1929. The current month's production consisted of 11.3 million pounds from Ontario, 8.3 million pounds from British Columbia and 6.4 million pounds from Quebec.

The average price of copper for the month was 10.693 cents per pound; quotations on the New York market ranged from 10.525 cents to 10.775 cents during the month.

Canadian gold producers reported a production of 169,621 ounces, a slight increase over the total for August, 1929. The Ontario production amounted to 133,741 ounces, made up from 67,446 ounces from Kirkland Lake, 60,756 ounces from the Porcupine area, and 5,539 ounces from other sources. British Columbia operators produced 15,522 ounces, an increase of 17.6 per cent. over the July figures. Quebec production totalled 11,898 ounces and included for the first time shipments from the Granada Rouyn mine. Operators in the Yukon, Manitoba, and Nova Scotia produced 8,460 ounces.

Lead production from Ontario, British Columbia and the Yukon totalled 25,540,814 pounds as against 26,218,998 pounds in July and 27,048,907 pounds in August, 1929. Lead quotations averaged 3.975 cents on the London market in August; the average price in July was 3.945 cents.

Nickel production in August was 9,088,052 pounds as compared with 9,379,712 pounds last month and 7,448,248 pounds in August, 1929.

The output of silver was slightly higher than in July and amounted to 2,036,001 ounces. The cumulative total for the first eight months of 17,258,696 ounces, is 8.1 per cent. above the output in the corresponding period of 1929. Silver was quoted at a slightly higher level during August; the average price was 35.192 cents per ounce as compared with 34.348 cents in July.

According to the " Engineering and Mining World " this advance was due to a better demand for silver by buyers in India and China.

Zinc output continued at a high level, amounting to 26,235,267 pounds, as against 19,936,626 pounds in July and 16,032,136 pounds in August, 1929. Shipments were made during the current month my the *Yukon, Base Metals*, and *Consolidated*. Zinc quotations on the London market averaged 3.466 cents per pound ; in August last year, the average price was 5,409 cents per pound.

Shipments of asbestos totalled 18,353 tons as compared with 17,070 tons last month and 29,254 tons in August, 1929.

Canadian coal mines produced 1,100,814 tons of coal during August, a falling-off of 17.2 per cent. from the five-year average for the month of 1,314,191 tons. Bituminous coal raised during August amounted to 886,406 tons, sub-bituminous coal, 56,755 tons and lignite coal, 157, 653 tons. The output in Nova Scotia was 536,585 tons, in New Brunswick, 16,831 tons, in Saskachewan, 19,236 tons, in Alberta, 388,307 tons, and in British Columbia, 139,855 tons.

Feldspar production amounted to 1,660 tons in August as against 5,363 tons produced during the corresponding month of the Canadian total.

Natural gas production rose to a higher level in August and amounted to 1,492,073 thousand cubic feet as compared with 1,391,124 thousand cubic feet in the corresponding month of last year.

Canadian wells produced 136,056 barrels of petroleum during August ; an increase of 10.7 per cent. over the July total and 22.1 per cent. over the output in Augnst, 1929. Alberta's production accounted for 92.4 per cent. of the Canadian output and consisted of 115,369 barrels of naphtha, 9,019 barrels of light crude, and 1,337 barrels of heavy crude.

COPYRIGHT IN JUGO-SLAVIA AND FRENCH COLONIES AND PROTECTORATES.

Under Section 29 of the Copyright Act, 1911, Orders-in-Council were made on October 27, extending the provisions of the Act to Jugo-Slavia and the French Colonies and Protectorates, which have acceded to the revised Berne Copyright Convention, 1908.

Copies of the order may be seen in the Patent Office Library, 25, Southampton Buildings, Chancery Lane, London, W.C.2.

MODERN FILTRATION PLANT FOR INDUSTRY.

A NOTABLE INSTALLATION IN SOUTHERN MANCHURIA.

By A WELL-KNOWN ENGINEER.

Enormous developments in mines, coke oven plant, iron and steel works, railways, power stations, docks and harbours, low temperature carbonisation of shale, and other activities, are now being carried out by the Southern Manchuria Railways Company, and in this connection of great interest is a water filtration plant that has been installed for the Fushun Collieries and Fushun Water Works.

The site of the Fushun Collieries is in the Province of Fengtien, South Manchuria, about 20 to 25 miles east of Mukden, and to-day about 60,000 people are empolyed at Fushun, Japanese, Chinese, and Koreans. Also the old and small town of Fushun is already almost swallowed up by the open cut mining operations and a complete new town on the most modern lines has been built to accommodate 90,000 people, and it is largely in this connection as well as the colliery that the Fushun Waterworks Company is operating. The plant was supplied in 1922 by the Paterson Engineering Co., Ltd., of London, consisting of a rapid gravity filtration equipment to deal with 4,320,000 gallons of water per 24 hours, and capable of extension by a further 1,500,000 gallons in the immediate futrue. There is provided chemical reagent gear for the continuous addition of alumina and lime to the raw water, as controlled automatically by the flow of the latter, using a venturi tube device, a reaction and prescipitation tank to mix the reagents with the raw water, and six standard " Paterson " compressed air being provided by an electrically driven air compressor with air storage reservoire, while the wash water is supplied from a high pressure main leading to the Rikako reservoid. This standard waterworks principle of water treatment will undoubtedly find more and more use in industry, that is filtering and purifying, with the us of coagulents if necessary, the supply for the whole of the process work, and not the boiler plant only. Another example of a large industrial " Paterson " plant is an installation now on order for the Japanese Imperial Steel Works at Yawata (Island of Honshiu) with a capacity of 12,662,000 gallons per 24 hours, and is designed for extension to 19,000,000 gallons, while the Tata Iron and Steel Works at Jamshedpur in India have a similar installation.

QUARRYING AND METALLIFEROUS MINING INDUSTRIES.

The Annual Report combining the information contained in the Inspectors' Reports relating to the Quarrying and Metalliferous Mining Industries for 1929 has been published. It deals primarily with questions relating to the health and safety of workers in and about metalliferous mines and quarries, but it also contains information about employment, output of minerals, use of explosives and electricity, etc. The quarries covered by the Report are those which are more than 20 feet deep.

During the year over 80,000 persons were employed in the quarrying industry and nearly 16,000 in metalliferous mines, and mineral was obtained to the value of approximately £15½ million and £4 million respectively. The progress in mechanisation in and about quarries has resulted in an increase of 27 per cent. in the output of mineral per person employed between 1924 and 1929.

Detailed statistics of accident rates are given for both industries. Brief descriptions of some of the accidents are given with suggestions as to ways in which many of them might have been avoided. Progress is being made in the matter of first aid arrangements at quarries and metalliferous mines, but the Report emphasises the desirability of as many men as possible being trained in first aid work, as, owing to the isolated situation of many mines and quarries, some time must often elapse before a doctor can arrive.

The Report is published at 1s. net (1s. 1d. post free), and may be obtained from any bookseller or directly from H.M. Stationery Office at Adastral House, Kingsway, London, W.C.2.

BRITISH OXYGEN COMPANY EXPANDING.

A fusion of interest has been arranged between the British Oxygen Company, Ltd., and Allen-Liversidge, Ltd., pioneers in the oxygen and dissolved acetylene industry, respectively. Circulars have been sent to the shareholders of both companies.

We believe that it is everywhere recognised that the oxygen industry was founded and developed by the British Oxygen Company, Ltd., whilst to Allen-Liversidge, Ltd., is mainly due, in later years, the contemporaneous development of dissolved acetylene. Consequently the proposals for fusion outlined in the circular cannot fail to

Proceedings and Notices of Societies

THE CHEMICAL SOCIETY.

Papers read November 20.

Piperitone. Part XI. Syntheses of Optically Inactive and Active Piperitylamines, Piperitols, and α-Phellandrenes. By J. Read and R. A. Storey.

dl-Piperitylamine has been obtained by reducing a product formed in the interaction of *l*-piperitone and hydrazine. When fractionally crystallised with a molecular proportion of *d*-tartaric acid, this base yielded a distinctive hydrogen tartrate of the form *d*A*l*B.

Researches in the Menthone Series. Part IX. A New Optical Resolution of dl-*Menthol and of* dl-*Camphor-10-Sulphonic Acid.* By J. Read and W. J. Grubb.

dl-Menthyl *d*-camphor-10-sulphonate, prepared by the interaction of *dl*-menthol and *d*-camphor-10-sulphonyl chloride in quinoline, furnishes pure *l*-menthyl *d*-camphor-10-sulphonate after four recrystallisations from light petroleum and ethyl acetate. Pure *d*-methyl *l*-camphor-10-sulphonate may be obtained in a similar way by the use of *l*-camphor10-sulphonyl chloride; the process is not hindered by the presence of a little of the antimeric acid chloride, and a yield of more than 40 per cent. of the calculated quantity of pure ester is attained. Hydrolysing agents furnish mixtures of *l*- (or *d*)-menthol and partly racemised *d* (or *l*)-Δ^3-methene from these two esters, the main reaction being $C_{10}H_{19}.O.SO_2R \longrightarrow C_{10}H_{18}+R.SO_2.OH$. Steam distillation of the second ester in presence of 50 per cent aqueous oxalic acid affords a 80 per cent. yield of crude *d*-menthol, $[\alpha]_D+36.5°$ (alcohol), leading to 10 per cent. of pure *d*-menthol, m.p. 42° $[\alpha]_D+49.8°$ (alcohol); pure *l*-camphor-10-sulphonyl chloride may be recovered from the residue.

dl-Camphor-10-sulphonic acid is readily resolved by conversion to the *l*-menthyl ester, three crystallisations of the product from ethyl acetate furnishing pure *l*-menthyl *d*-camphor-10-sulphonate in about 65 per cent. yield. When heated a little above 150°, the ester decomposes quantitatively into pure *d*-camphor-10-sulphonic acid and partly racemised *d*-Δ^3-menthene, having $[\alpha]_D+19.8°$ (alcohol).

Heterocyclic Systems Containing Selen-

The interaction of hexamethylene dibromide and sodium selenide leads to the formation of a small quantity of monomeric *cycloselenohexane* (I) which is accompanied by a *dimeride* and a complex *polymeride* of high molecular weight. *cyclo*Selenohexane affords additive compounds with the halogens, mercuric chloride, and methyl iodide. The foregoing polymeride decomposes on heating without loss of selenium into a six-membered ring compound, 2-*methylcycloselenopentane* (II) which also condenses with the halogens, methyl iodide, and mermuric chloride.

Potassium selenocyanate and hexamethylene dibromide furnish *hexamethylene diselenocyanate* which hydrolyses with alkalis to cyclo*hexamethylene* 1 : 8-*diselenide*. This diselenide pyrolyses to 2-methyl*cyclo*selenopentane at 250°.

Bis-p-*Phenetyl Telluride and its Derivatives*. By G. T. MORGAN AND F. H. BURSTALL.

During an investigation on the parachor of tellurium (Burstall and Sugden, *J.*, 1930, 229) it was found that the observed molecular parachor of bis-p-phenetyl telluridichloride $(EtO.C_6H_4)_2TeCl_2$ gave a value which suggested that this dichloride was a nuclear substituted telluride $(Eto.C_6H_3Cl)_2Te$. *Bis*-p-*phenetyl telluridichloride* has now been prepared by a method which leaves no doubt as to its constitution; *bis*-p-*phenetyl telluride*, $(EtO.C_6H_4)_2Te$, made by the Grignard reaction between tellurium dibromide and the magnesium compound of *p*-bromophenetole, readily combines additively with chlorine forming a dichloro-derivative which is identical with the dichloride formerly described (*loc. cit.*).

On hydrolysis with boiling water or warm aqueous caustic alkali the dichloride furnishes respectively *bis*-p-*phenetyl telluri-oxychloride* $(EtO.C_6H_4)2TeCl.O.TeCl(C_6H_4.OEt)_2$ and *bis*-p-*phenetyl tellurioxide* $(EtO.C_6H_4)_2$ Te :O. The three *bis*-p-*phenetyl telluridihalides* $(EtO.C_6H_4)_1TeX_2$ are decomposed in a noteworthy manner by concentrated nitric acid (*d* 1.4) and give rise to *o*-halogenated-*p*-nitrophenetoles, the yield being greatest in the case of the iodide.

A mixed p-*anisyl*-p-*phenetyl telluridichloride* has been prepared and reduced to p-*anisyl*-p-*phenetyl telluride*.

Researches on Residual Affinity and Co-ordination. Part XXXII. Complex Salts of Bivalent Silver. By G. T. MORGAN AND F. H. BURSTALL.

The series of complex argentic salts described in the present communication show that stable compounds of bivalent silver can be obtained containing either two or three molecules of αα'-dipyridyl. These substances are crystalline and highly coloured and their solutions are strong oxidising agents.

THE PHYSICAL SOCIETY.

November 21.

The Determination of the Acoustical Characteristics of Singly-Resonant Hot-wire Microphones. By E. T. PARIS, D.Sc., F.Inst.P.

A method is described for measuring the damping-coefficients and conductances of the orifices of the small resonators used in the construction of hot-wire microphones Observations show that resonant microphones with cylindrical necks of diameter between 0.5 and 0.64 cm. and length between 1.2 and 2.25 cm. have damping-coefficients which are about 23 per cent. greater than the values indicated by theory. The observed conductances of the necks agree very closely with those calculated from a formula in which allowance is made for the added inertia due to viscosity.

The Spectrum of Doubly-Ionised Arsenic. By K. R. RAO, D.Sc., Madras Government Research Scholar, University of Upsala.

The doublet system of AsIII, published by R. J. Lang, has been amended and extended in the light of fresh observations which have been made, and a scheme of terms has been evaluated.

The Effect of Temperature on Spark-Potential. By H. C. BOWKER, B.Sc.(Eng.), Ph.D., A.K.C.

The effect of temperature on spark-potential in hydrogen and nitrogen at ordinary pressures has been studied up to 860° C., over 6,000 voltmeter readings having been taken. The spark-potential is found to depend on the intensity of the gas and to be independent of temperature and pressure for a given density. Additional ionisation of limited amount does not lower the spark-potential at ordinary densities.

The Curie Points. By L. F. BATES, Ph.D., University of London, University College.

Attention is directed to the fact that at least three temperatures may require to be specified in a description of the magnetic behaviour of a ferromagnetic substance. These are respectively termed the ferromagnetic critical point, the ferromagnetic Curie point, and the paramagnetic Curie point. The significance of the relative positions of

ROYAL AGRICULTURAL SOCIETY.

November 5.

In his report to the Chemical Committee, Dr. Voelcker referred in detail to two important legal decisions which had been given recently, the one concerning the nature of what should constitute ' Barley Meal," the other in regard to the liability attaching to the sale of feeding-cakes, etc., containing castor-oil bean. In the case of barley meal it had been ruled that, for this to comply with the requirements of the Fertilisers and Feeding Stuffs Act, 1926, it shall be made by grinding barley containing not more than 4 per cent. of matters other than barley.

The Consulting Chemist further drew attention to matters that had arisen in the course of his examination of samples sent by members :—

Soil Deficient in Lime.—This, a brown loamy soil from near Ambleside, and intended for a forest-tree plantation, was found to be decidedly acid and to contain only .22 per cent. of lime, together with the excessive amount of .67 per cent. of magnesia.

Peruvian Cotton Cake. A sample sent gave the following results :—

Moisture	9.81
Oil...	6.46
*Albuminoids	35,00
Carbohydrates, etc.	32.22
Woody fibre	10.52
†Mineral matter	5.99
	100.00
*Containing Nitrogen	5.60
†Including Sand	.18

This was a pure and clean cake, and of higher quality than undecorticated cotton cake usually is. The price of this cake is at present £7 12s. 6d. per ton.

Sugar-Beet.—Two samples, fairly taken from representative portions of two crops, the one being from German (Wanzleben) seed, and the other from Dutch seed, were analysed for sugar, and gave :—

	German	Dutch
Percentage of Sugar (cold extraction)	16.00	20.1

Waste Lime from Sugar-Beet Purification.—A sample of this gave the following analysis :—

Moisture	16.89
Organic Matter	14.78
Oxide of Iron and Alumina	3.18
Lime (total)	37.16
Carbonic Acid, etc.	26.60
Sand	1.39

The lime was present almost entirely as carbonate, there being but little caustic lime. Such a material would not pay for transport from any considerable distance, and would only be of use when obtainable near at hand.

Mr. Brocklehurst referred to the barley meal. The Council would remember that in the Fertilisers and Feeding Stuffs Act of 1926 the definition of barley meal was, " grinding commercially pure barley as grown." Speaking from experience, he had not yet found a single person who had been able to give a definition of what that meant. Traders in foreign barley had taken it to mean that they might grind up the barley and mix it with barley of a very inferior quality. That had meant a great hardship on the home producer and the result had been that barley meal all over the country had deteriorated in quality to a very considerable extent. Exactly a year ago he attended with Mr. Smith and Dr. Voelcker as a deputation to the Ministry of Agriculture. The Ministry was very sympathetic, and had promised to take the matter before the Advisory Committee, but he was sorry to say that that august body, in spite of the efforts of Dr. Voelcker, could not see its way to giving a clearer definition. Last July the Middlesex County Council had instituted a prosecution for selling impure barley meal, and he was pleased to say that, after very careful consideration, a fine of five guineas and twenty guineas costs had been imposed. At last they had a definition with regard to what barley meal was, namely, that it was not to consist of more than 4 per cent. of other ingredients or impurities.

ROYAL MICROSCOPICAL SOCIETY.

An Ordinary Meeting of the Society was held in the Hastings Hall at the Society's new premises, B.M.A. House, Tavistock Square, W.C.1., on Wednesday, November 19, at 5 p.m. The following papers were read and discussed :—

" A Universal Tube Length and Cover-Glass Correcting Lens System for Use with Microscope Object-Glasses." By R. J. Bracey, F.Inst.P.

" Microscopical Studies in Pernicious Anæmia. I—The Hæmoglobiniferous Cells." By Dr. W. E. Cooke, M.D., F.R.C.P., D.P.H., F.R.M.S., and Mr. C. F. Hill,

FORTHCOMING PUBLICATIONS.

Radiations from Radioactive Substances, by Sir Ernest Rutherford, Dr. James Chadwick, and Dr. C. D. Ellis, will be published in November by the Cambridge University Press. This new work will take the place of "*Radioactive Substances and their Radiations*," which was published in 1913 and which has been out of print for some years. The work is confined to an account of the radiations from active matter and their application to physical problems, the authors' object being to give a concise and connected account of our knowledge of the radiations, and of the bearing of the results on the problem of the structure of the nucleus.

CORRESPONDENCE.

BRITISH ROAD MATERIALS.

43, Park Street,
Stoke Newington, N.16.

20 November, 1930.

(*To the Editor of* THE CHEMICAL NEWS.)

Sir,—The plea in your issue of the 14th ult., for the use of tar on our roads in preference to other materials is based on the contention that we must at all costs support the gas industry by purchasing its by-product, tar, irrespective of whether or not it is the best material for the purpose required. But is it sound policy thus artificially to stimulate one British industry at the expense of another? And why single out the gas industry for this preferential treatment? We might with equal justice inaugurate a campaign for rubber roads in order to assist the British rubber producers.

England's industrial supremacy has been built up by allowing the free play of economic forces and by allowing the extent of the use of each product to be dictated by the service it can offer. When other road materials can offer a better service than tar, their use should be freely open to all who require them. If such secondary considerations which you have brought forward had been allowed to weigh in the past, we should still have sailing ships and horse-'buses.

Yours faithfully,

LEONARD A. RICH.

NOTICES OF BOOKS.

Systematic Inorganic Chemistry. By PROF. R. M. CAVEN AND DR. G. D. LANDER. New and enlarged edition pp. xviii + 510. London and Glasgow: Blackie & Sons. 1930. Price 9s.

The present edition of this well-known textbook for advanced students, based systematically on the Periodic Classification of the elements, has been extended to include the more important results of recent chemical research work. Besides these additions there is an important final chapter entitled, 'The Problem of the Origin and Destiny of the Elements,' in which the authors discuss such matters as radioactivity, atomic numbers, isotopes, atomic structure, etc., and put forward their views on the origin of the material universe and other philosophical matters.

There is also a valuable lengthy appendix containing notes on constitutional formulæ according to the electronic theory of valency which will be useful for advanced students and others who wish to understand recent developments in theoretical inorganic chemistry.

Chemische Thermodynamik. By PROF. DR. ULICH. Pp. xvi + 353. Dresden and Leipzig: Theodor Steinkopff. 1930. Price 18 marks 50 pf.

Prof. Ulich divides his work into six sections dealing, respectively, with (1) Laws and Definitions; (2) Simple Applications of Thermodynamical Principles to Chemical Reactions; (3) Thermodynamics and the Phase Rule; (4) Nernst's Theorem; (5) Thermodynamics of Mixed Phases; and (6) Surface Phenomena and Adsorption.

The subject is developed with numerous examples and is well illustrated and special reference has been made to the work of the Author, Schottky and Wagner and represents a valuable contribution to a difficult but nevertheless important branch of physical chemistry.

The Materials of Life. By T. R. PARSONS, M.A., B.Sc. Pp. xii + 288. London: George Routledge & Sons, Ltd. 1930. Price 10s. 6d.

It is only just over a hundred years ago since Wohler synthesised urea and thus laid the foundations of Organic Chemistry as a distinct branch of science. Since then knowledge in all sciences has advanced, chiefly along definite self-contained lines.

To-day the tendency is for the borderland of two sciences to be explored and the independent achievements in the individual *sciences to be applied to the further study* of the problems of the other branches of natural knowledge.

Biochemistry has now become a definite branch of science, a meeting ground for the application of chemistry to biology, and the present volume is an attempt to give a simple account of the subject.

It deals with the chemical nature of the materials composing living organisms and the changes these undergo during growth and life. The assimilation of foodstuffs and the changes which these undergo during digestion.

A detailed description is given of the more important substances like sugar, starch and fat and vitamins and such substances as blood, health and disease and the "cycle of Nature" are dealt with in considerable detail.

The author has written a valuable work which is useful not only to the student, but should serve also to inform the educated public of the aims and achievements of biochemistry.

ECONOMIC CONDITIONS IN SYRIA.

The only outstanding event of political importance which has occurred in any part of the French Mandated Territory, since the last report in May, 1928, was issued, is the promulgation by the French High Commissioner on May 22nd, 1930, of a constitution for the state of Syria. This is too recent for its effect to be felt, and therefore such alterations as have taken place in the economic state of the country are due to natural causes.

The country is stated to be passing through a period of trade depression. Blame is laid in part on the system of extended credit granted by some foreign firms as this leads to overstocking, and to the poor prices obtainable for the bumper cereal crop of 1928.

The section "Business Methods" describes *the various classes of importing firms* and discusses the advisability of the grant of credit, urging the necessity for adequate status enquiry in the first instance.

British imports have maintained their position during the period under review, although the value of imports from the United States exceeded those from Great Britain, this change being due in the main to the import of wheat owing to the bad harvest of 1928. Details of the position in certain in*dividual trades are given under the heading* "Imports."

The development of Transport facilities is dealt with in the section bearing that title Advice is also given as to the best times for business visits, routes, Etc. The report is issued by the Dept. of Overseas Trade, and is obtainable for His Majesty's Stationery Office, Adastral House, Kingsway, London, W.C.2.

PUBLICATIONS RECEIVED.

THE INSTITUTE OF CHEMICAL RESEARCH, KOMAGOME HONGO, TOKYO, JAPAN.

Thickness of the Oxide Film which produces Temper Colours on Iron. By M. Kuroda. No. 627. 25 Sen.

Resistance of Impact on Water Surface Part 11.—Cone (continued). By S. Watanabe. No. 268. Price 25 Sen.

On the Stark Effect of Aluminium and Carbon. By Y. Ishid and M. Fukushima. No. 266. Prices 40 Sen.

UNITED STATES OF INTERIOR.

Surface Water Supply of the United States 1926. Part X The Great Basin N.C. Grover, Chief Hydraulic Engineer. Water Supply Paper 630. Price 25 cents.

Geology and Mineral Resources of Northwestern Alaska. By P. S. Smith, and J. B. Mertie, Jr. Bulletin 815. Price $1.00.

UNITED STATES DEPARTMENT OF COMMERCE.

Interchangeable Ground Glass Joints. Commercial Standard CS21-30. Price 15 cents.

Effects of Gases on Photo-Ionization of Caesium by Line Absorption. By F. L. Mohler, C. Boeckner. Research Paper No. 208. Price 5 cents.

Copper Electrotyping. Circular of the Bureau of Standards, No. 387. Price 10 cents.

UNION OF SOUTH AFRICA. DEPARTMENT OF AGRICULTURE.

The Coat of the Angora Goat. By Prof. J. E. Duerden, M.Ss., Ph.D., F.T.I. Bulletin No. 83. Price 3d.

Flue-Curing of Tobacco. By W. R. Thompson, B.Sc.Agr. Bulletin No. 88. Price 3d.

New Methods for the Control of Codling Moth. By F. W. Pettey. Bulletin No. 90. Price 3d.

Forthcoming Events.

ROYAL SOCIETY OF ARTS.
John Street, Adelphi, W.C.2.

Monday, December 8, at 8 p.m.—Cantor Lecture. "Modern Domestic Scientific Appliances." (Lecture III). By Professor C. R. Darling, F.I.C., F.Inst.P.

Wednesday December 10, at 8.30 p.m.—Ordinary Meeting. "Persian Textiles." By A. L. B. Ashton, of the Department of Textiles, Victoria and Albert Museum. Sir E. Denison Ross, C.I.E., Ph.D., Director of the School of Oriental Studies (University of London), will preside. The paper will be illustrated by lantern slides.

Friday, December 12, at 4.30 p.m.—Indian Section. — "India's Commercial Fibres." By Alfred Wigglesworth. Lt.-Col. Sir David Prain, C.M.G., C.I.E., F.R.S., will preside.

THE ROYAL INSTITUTION.
21, Albemarle Street, W.1.

Tuesdays, December 2 and 9, at 5.15 p.m. —"Stellar Structure and the Origin of Stellar Energy." By E. A. Milne, M.A., M.Sc., F.R.S.

Thursdays, December 4 and 11.—"The Agricultural Development of the Empire. I. Reclaiming the Wastes. II. Conquest of the Drought."

Saturdays, December 6 and 13.—"Persia and Persians. I The Country and its History. II Art and Literature." By Sir E. Denison Ross, C.I.E., Ph.D.

THE INSTITUTE OF METALS.
BIRMINGHAM LOCAL SECTION.

Saturday, November 29.—Dinner and Dance, Queen's Hotel.

NORTH-EAET LOCAL SECTION.

Tuesday, December 9, at 7.30 p.m., in the Electrical Engineering Lecture Theatre, Armstrong College, Newcastle-on-Tyne.—"Properties of Coke." By Prof. H. V. A. Briscoe, D.Sc.

SWANSEA LOCAL SECTION.

Tuesday, December 9, at 6.15, in the University College.—Lecture and Demonstration on "Copper Welding." By W. Andrews and H. Martin.

MANCHESTER CHEMICAL SOCIETIES.
INSTITUTE OF CHEMISTRY.

Thursday, December 4, at The Manchester, Ltd., Royal Exchange. — Annual Dinner and Dance.

SOCIETY OF CHEMICAL INDUSTRY.

Friday, December 5, at 7 p.m., in the Engineers' Club, 17 Albert Square :—

"The Estimation of Minute Traces of Copper." By Dr. T. Callan, M.Sc., F.I.C.

"The Reaction of Formaldehyde Derivatives with Cellulose." By Dr. F. C. Wood, M.Sc., F.I.C.

"The Formation of Mono-Cellulose Methylene Ether." By Dr. F. C. Wood, M.Sc., F.I.C.

"The Action of Grignard Reagent on Cellulose." By Dr. F. C. Wood, M.Sc., F.I.C.

"Some Notes on Viscose Dyeing." By Dr. C. M. Whittaker, B.Sc.

"A Skin Effect on Viscose Rayon." By J. M. Preston, B.Sc., A.I.C.

THE SOCIETY OF DYERS AND COLOURISTS.

Friday, December 12, at 7 p.m., in the Lecture Room of the Lit. and Phil. Society 36, George Street.—"Theories of Lustre." By J. M. Preston, B.Sc., A.I.C.

"Notes on the Iodine Mercerisation Test." By W. F. A. Ermen, M.A.

ROYAL INSTITUTE OF PUBLIC HEALTH.

Wednesday, December 3, at 4 p.m., in the Lecture Hall of the Institute, 37 Russell Square, London, W.C.1.

"The Prevention of Disorders and Disease in Tropical Countries." By Prof D. B. Blacklock, M.D., D.P.H., D.T.M.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

33,929.—I. G. Farbenindustrie Akt.-Ges.—Manufacture of 2-aroyl-1 : 9-isothiazoleanthrones. November 11.

34,349.—I. G. Farbenindustrie Akt.-Ges.—Manufacture of acetaldehyde and acetic acid. November 14.

34,350.—I. G. Farbenindustrie Akt.-Ges.—Manufactnre of polymerisation prodncts. November 14.

34,360.—I. G. Farbenindustrie Akt.-Ges.—Manufacture of acridine derivatives. November 14.

Specifications Published.

317,325.—I. G. Farbenindustrie Akt.-Ges. —*Manufacture of a basic product* derived from moleic acid.

337,821.—I. G. Farbenindustrie Akt.-Ges. —Process for the manufacture of 2- and 3-hydroxy carbazoles.

337,847.—Caro, N, and Frank, A. R. — Working-up oxides of nitrogen.

Printed copies of the full Published Specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2., at the uniform price of 1s. each.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

SILANTOX.

515,678.—Chemical substances used for agricultural, horticultural, veterinary and sanitary purposes.—Silica Gel, Ltd., Bush House, Aldwych, London, W.C.2 November 19. (Associated).

CORONET.

515,994.—Photographic chemicals, plates and films (sensitised).—Frederick John Pettifer, trading as The Coronet Camera Co., 48, Great Hampton Street, Birmingham. November 19. (Associated.)

VIVERAL.

515,788.—All goods in class 1 which includes chemical substances used in manufactures, photography, or philosophical research and anti-corrosives. Kalle and Co., Aktiengesellschaft, 23, Rheinstrasse, Biebrich - on - Rhine, Germany. November 19. (Associated.) (By consent.)

OLOVIN.

515,051.—All goods in class 1 which includes *chemical substances used in* manufactures, photography, or philosophical research and anti-corrosives. — Consortium fur Elektrochemische Industrie Gesellschaft mit Beschrankter Haftung, 20, Zielstattstrasse, Munich, Germany. November 19. (Associated.)

GRAMMAR OF LOGIC.

100 Questions and Answers on The Grammar of Logic or *How to Reason Correctly*. By J. E. Roscoe, M.A., Oxon.

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BRITISH PATENT.

The owners of Patent 263779 for "IMPROVEMENTS IN OR RELATING TO THE PREPARATION OF SOLUTIONS OF HYDROFLUOSILICIC ACID," are desirous of negotiating with interested parties for the granting of Licences thereunder on reasonable terms.

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POLAROGRAPHIC STUDIES WITH THE DROPPING MERCURY CATHODE. — PART XIII. — THE EFFECT OF PROTEINS.

By J. HEYROVSKY AND J. BABICKA.

In the application of the polarographic method to biochemistry investigations of solutions containing blood or serum were carried out by F. Herles and A. Vancura in this laboratory : current-voltage curves due to aqueous solutions of serum from human blood exhibited always an increase of current in the form of a " wave " beginning at a voltage—1.6v. *i.e.*, 0.4 v. before that due to the deposition of sodium. The height of his " wave " forms about $^1/_{10}$ of that due to the deposition of sodium. The substance causing this electro-reduction remained unknown until the present authors observed that the presence of ammonium ions in solution of serum causes an enormous increase of this " wave," although the deposition potential of ammonium occurs at a voltage by ca. 0.2v. more negative. Further investigations have ascertained that the " wave " occurring before that of sodium or ammonium depends on the simultaneous presence of serum as well as ammonium ions in solution and that any albuminous substance substituted for the serum causes the same sort of "wave," provided ammonium ions are present in the solution.

Whilst the investigations of F. Herles and A. Vancura are of a purely medical character and will be described elsewhere, the general experiments and the theory of the polarographic " protein test " will be here described.

EXPERIMENTAL.

Chiefly the new type (VI.) of the "polarograph " was used, driven by motor, as constructed by V. Nejedly.[1]

Most of the curves were obtained by electrolysing the solutions open to the air, since the " protein wave " occurs at a voltage, at which the saturation current due to the reduction of atmospheric oxygen is already reached; therefore the beginning of the curves is placed usualy at −1.2 v. or −1.4 v. Such a procedure is quick and convenient, as it does not require bubbling of hydrogen and precautions against the penetration of air; its only drawback is that full sensitivity of the galvanometer (5.10^{-9} amp. p. mm) cannot be used, but maximally $^1/_{10}$.

[1] Dr. V. Nejedly, Prague XIX, Husova 76.

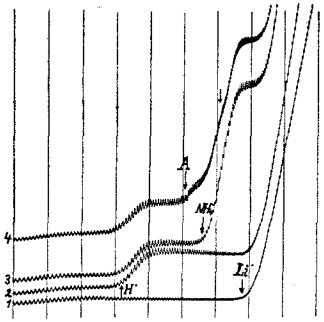

Fig. I.

1. Pure 0.02 n. LiCl.
2. added 6 drops 0.1 n. HCl,
3. ,, 5 ,, n NH_4Cl,
4. ,, 4 ,, 2 per cent. solution of flour to 35 ccs. Sens. $^1/_{100}$.

The position of the "protein wave" is shown in the polarogram Fig. I. The first curve exhibits only the bend due to the deposition of lithium from its 0.02 n. solution which occurs at the cathodic potential of −2.1 v. The next curve denotes the deposition of hydrions from hydrochloric acid added, at −1.4 v. (6 drops of 0.1 n HCl to 35 ccs). A further addition of ammonium chloride, which is pre-requisite for the "protein-wave," shows the beginning of the deposition of ammonium ions at −1.8 v. (+5 drops n. NH_4Cl). Some 0.2 v. earlier appears finally the "protein wave" due to an addition of 4 drops of a 2 per cent. aqueous solution of flour to 35 ccs of the solution containing the ammonium chloride, lithium chloride and hydrochloric acid.

The polarogram Fig. 2 shows the increase of the "protein wave" when one hundred times diluted human serum was gradually added to 10 ccs. of an aqueous solution containing 0.02 n. NH_4Cl and 0.126 n. LiCl. The height of the "albumin wave" increases proportionally to the amount of serum added.

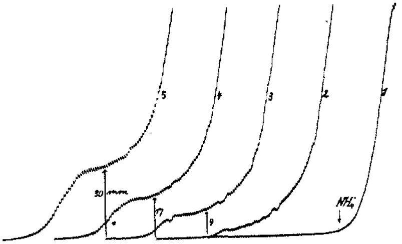

Fig. 2.

1. 0.02 n. NH_4Cl, 0.146 n. LiCl; added 2. 0.12 cc.,
3. 0.25 cc., 4. 0.50 cc., 5. 1.00 cc. of 1 per cent. serum to 10 ccs. Sens. $^1/_{100}$

(In the polarograms Fig. 2—6 the scale of the abscissae, denoting voltage, is four times increased, by applying a suitable resistance at the ends of the potentiometric wire of the polarograph.)

To prevent the flocculation of the serum, any dilution has to be made by an isotonic solution, *e.g.*, by the 0.85 per cent. sodium chloride solution. For the polarogram Fig. 2, however, the serum was diluted by a 0.146 n. LiCl solution (which is iso-osmotic with the usual physiological solution) merely to prevent bringing sodium ions in solution, which would complicate the curve. If diluted by pure water, the serum solutions show a quickly and irregularly decreasing albumin content, so that in a dilution 1 : 1000 hardly any "wave" is observable on the curve.

The best solvent, however, to dilute liquids from living organism (serum, egg albumen, urine) proved to be a 0.146 n. NH_4Cl solution, in which case the protein test is most distinct, when the solution after dilution is allowed stand for several hours cold.

Further additions of hydrochloric or acetic acid produced no effect on the position of the "protein wave," and equally indifferent were small additions of alkalies, like lithium hydroxide. However, larger alkalinity caused decrease of the "wave," evidently because the necessary amount of ammonium ions was hereby removed.

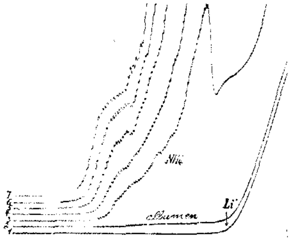

Fig. 3A.
1. pure 0.02 n. LiCl.
2. added 0.3 cc. of 1 per cent. white of egg,
3. ,, 0.1 cc. n. NH_4Cl, 4. 0.2 cc.,
5. 0.5 cc. 6. 1.0 cc. of n. NH_4Cl.
Sens. $^1/_{400}$.

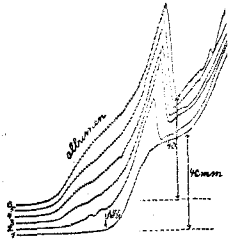

Fig. 3B.
1. pure 0.02 n. NH_4Cl, 0.02 n. LiCl; added:
2. 0.1 cc. 3. 0.25 cc., 4. 0.50 cc.,
5. 1.0 cc. 6. 1.5 cc. of 1 per cent. white of egg.
Sens. $^1/_{400}$.

The rôle of ammonium ions is demonstrated by the polarogram, Fig. 3. If the content of diluted white of egg in solution is kept constant, the "wave" is proportional to the concentration of ammonium ions; if this is nil, no effect is observable, unless the albuminous solution itself is contaminated salt is added, the "wave" grows to a limit reached (in Fig. 3 A) in a 0.2 n. NH_4Cl solution. This limit is regarded as a quantitative measure for the content of albumins. Other agents were looked for, which would substitute this action of ammonium ions; of these the hydrochlorides of quaternary amines, urea, creatin, betain did not promote the appearance of the "protein wave." However, glycocol, asparagine and hydrochlorides of secondary amines were found to act similarly to ammonium ions. The height of the "protein wave" may be looked upon as a part of the ammonium "wave." This indeed suggests itself from experiments represented in the Fig. 3. Here the concentration of ammonia in solution is unchanged and only that of albumin is added, that the "protein wave" reaches the height of the ammonium "wave," further additions do not increase the diffusion current, although they still increase the adsorption maximum in which the "albumin" and the ammonium waves conjointly terminate.

Evidence for proteins being the cause of the increase of current before that due to the ammonium ion seems sufficiently well established. Next to the investigation of serum pure crystalline egg-albumen was added to solutions containing ammoninm ions and the "protein wave" always appeared, proportional to the amount of the egg-albumen (Fig. 4); the solution, however, was not clear, which caused some discordant results.

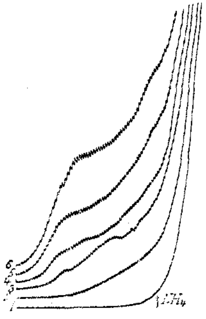

Fig. 4.
1. pure 0.146 n. NH_4Cl; added : 2. 0.10 cc, 3. 0.20 cc., 4. 0.40 cc., 5. 0.80 cc., 6. 1.60 cc. of 1 per cent. crystalline egg-albumen to 10 ccs. Sens. $^1/_{300}$.

RATIONALIZATION.

By L. M. ANGUS-BUTTERWORTH, F.R.G.S. F.Z.S., F.S.A. SCOT.

(*Continued from page 356.*)

The great industralist, W. L. Hichens, has put the issue quite plainly. When speaking in Manchester recently he said, "There are at present too many shipyards and too many steel-works, and the first thing to be done if these industries are to be restored to a healthy condition is to re-establish an equilibrium between production and consumption. When once this has been done expansion may again become possible, but it must be an expansion based on modern *plant adapted for modern needs, not on the* rehabilitation of antiquated plants and antediluvian methods." The same remarks apply with equal force to the cotton, glass and other industries. This matter of productive capacity has been treated at some length because of its immense importance in connection with rationalisation. It is well known that even before the war competition with the continent was becoming more and more acute. Now the whole world is becoming industrialised, and means must be found for regulating productive capacity. We can either adopt rationalisation or allow the old methods of competition and individualism to continue. If the latter is chosen it is inevitable that the bankruptcy courts should *be kept busy. And we cannot comfort our*selves with the thought that the most efficient firms will survive. It has been found in practice that when there is fierce competition all firms get a share of the available orders, and accordingly work well below full capacity. It will be evident that firms with the most modern and expensive equipment will be penalised if working to, say, only half capacity on account of their high overheads. An up-to-date firm with costly machinery standing idle may lose much more heavily in proportion than an ill-equipped concern with low overheads. The best plants are most efficient when working at or near full capacity, and this is no doubt one reason why the leading firms in any in*dustry are usually the first to take advan*tage of rationalisation. But in a complete scheme of rationalisation the ideal is for the group to be sufficiently large to include both efficient and non-efficient plants. The work of the badly-equipped firm can then be transferred to the better equipped ones, and their factories closed down.

Concentration of production requires very careful planning. The considerations involved include the availability or otherwise of labour, raw materials, cheap power, cheap transport, etc., and the disposal of the finished goods and by-products. As a rule it is found most economical for production to be concentrated in a few main centres. In this way stocks of spare machinery and plant, and of raw materials, can be reduced, and better technical control obtained. This theory is not pushed so far as to concentrate the entire production at one spot for any commodity, because it is found among other things that by having the manufacture carried on at a few centres the competitive spirit is preserved and improvements are made. Even under rationalisation it may be that when the product is used over a wide area and the transport charges are heavy in relation to the cost of the material itself, the most economical course may be to have a number of small units distributed over the country. While such cases are rare it may be pointed out that the excessive carriage charges of our railways impose an extremely heavy burden on all our national industries. It need hardly be pointed out that the railways are *not* an example of a rationalised industry. It would be more correct to regard them as a badly conducted monopoly whose swollen staffs are little more than parasites living on the workers in unsheltered industries. To rationalise the railways in the true sense of the term could cause a substantial reduction in railway carriage rates, which in turn would go very far towards bringing about a revival of trade in this country. I know of goods made in Lancashire, at well below the price of the foreign equivalent, which cannot be sold in the south of England because of the high rail charges. Many large firms now deliver their goods over a wide area by motor, because they find that delivery by road is cheaper than sending by rail.

We have now seen a part or the whole of an industry brought under one control, finance arranged, and production concentrated in the best available factories. A step which commonly follows at this stage is the standardisation of products and processes. It very often happens that a number of firms will be offering the same product with just superficial differences introduced to distinguish it from what is being sold by competitors. Simplification and standardisation here lead to cheaper production. Under rationalisation in the United

States standardising has been found to be very profitable. The United States Department of Commerce state that is a result of rationalisation, to give two examples only, the variety of pipes and fittings has been reduced from 17,000 to 610, and of stoves and ranges from 2,982 to 364. In this country the work of the British Engineering Standards Association in this connection is well known. The most desirable point about standardisation is, of course, that it allows mass-production methods to be adopted and thus quickly reduces the price to the consumer.

Processes require to be standardised just as much as the products themselves. In most industries there are several different methods of making a particular product, and each varies in its degree of efficiency. In a rationalised industry the technical staff can decide which method is the cheapest and most efficient and adopt it for all the factories in the group. The same reasoning applies equally to the plant and machinery used for the process. As far as one can see it is impossible without rationalisation to obtain this uniformity of products and plant.

A very interesting side to the question of rationalisation, and one closely connected with methods of production, is that of research. We know that to-day almost every industry depends very largely on research to maintain its position. Constant research work is essential to keep level with or draw a little ahead of competitors. But if the industry is split up among numerous competing units we generally find that the smaller works are unable to afford any research staff, and that the larger firms are to a great extent overlapping and duplicating each other's research work. In addition, when anything of importance is discovered it is naturally kept secret as long as possible while the particular works concerned secures whatever commercial advantage it can.

Under rationalisation research and development can be fully co-ordinated and organised; waste of time and money by unnecessary duplication can be avoided; and through the general control of a Director of Research the research work undertaken can be turned into the most fruitful or promising channels. It may be argued that these advantages might be obtained just as easily by indeoendent firms jointly supporting a central research association. But while this is true up to a point, it is unavoidable that research associations should deal mainly with fundamentals. The application of scientific data to industrial purposes is therefore a different field, and one in which there is room for much greater co-operation. From what observation I have been able to make myself I should say that one of the most striking results of rationalisation is the immensely increased provision that is at once made for research.

A somewhat obvious outcome of rationalisation is the advantage it gives in buying and selling. To purchase raw materials in bulk is naturally a great economy, and better inspection and stocking arrangements can be made when large quantities are in question. The gain is even more important in selling the finished product. The number of middlemen can be reduced, and a more effective sales and advertising organisation established. Thus if six little-known brands of, say, tooth paste, each of which is only advertised on a small scale, are replaced by a single brand which is given six times the amount of advertisement that any one make had before, the rationalised product is likely to meet with a popularity which its humble forerunners could not hope to attain. It has even heen asserted that large-scale advertising is the only kind that is really effective, and this is precisely the type that a rationalised industry is able to afford.

Critics of rationalisation sometimes suggest that by eliminating internal competition within an industry prices are maintained at a higher level than is justified by the costs of production. Although this is usually denied I believe it to be at least partly true, and yet to be a good thing. Rationalisation does tend to stabilise prices, and this I feel should give confidence to the buyer. No mau likes to buy in a falling market, and if rationalisation can bring about steady conditions it seems only reasonable to expect that larger orders will be placed, and a revival in trade come nearer realisation. Also by keeping prices at a fixed level I understand that wages and salaries can be maintained, again helping to establish general stability.

Labour is inclined to be a little suspicious of rationalisation, and to give it a rather unfriendly reception. This attitude cannot, of course, be justified. The interests of the community at large must be considered before those of individuals, and rationalisation does increase the general purchasing power of the public. Workers are painfully aware that when labour-saving machinery is introduced under rationalisation fewer

hands are required. They are therefore inclined to accept the fallacy that to abolish the labour-saving devices, or to prevent them being installed, is to preserve their own jobs. This view is very short-sighted, and we know that the reverse is true. If we do not install efficient modern plant our foreign and continental competitors will certainly do so, and it will then be a case of dismissing entire staffs rather than just a proportion of them. The first aim of rationalisation is to stop the rot and make safe the livelihood of the maximum number than can be employed under present-day mechanical methods of production. Old methods and inefficiency may appear to provide more employment, but they represent conditions that cannot last, and we are obliged to build for the future. By better methods of production rationalisation does in fact increase consumption, and thus in the long run also increases employment.

One of the features of rationalisation that have so far received least attention is the position of the middleman. In some cases he has been deprived of his occupation, and much hardship has resulted, but on the other hand most retailers, who may be regarded strictly as middlemen, have continued to make large profits even in these times of acute trade depression. There is good reason for the belief that the high charges of stores and shopkeepers has hampered and decreased the production of many commodities. There is often a wide gulf between wholesale an retail prices. Cotton goods, for example, remain expensive in the shops while the mills sell at lower and lower figures. In order that rationalisation should be completely effective it is necessary the advantage of lower costs of production should be passed on to the consumer, for only in this way can increased consumption be obtained. In a rationalised industry the place allocated to the middleman is not very large, as will be illustrated by the following happening. A man met a workman running, and upon asking him where he was going, received the reply, " To the undertakers. We have had an accident at our place." " Surely you mean the doctor? " " No," replied the workman, " the undertaker. We're rationalised, and have cut out the middleman ! "

Our last point in connection with the relationship between labour and capital under rationalisation is the position of the trades unions. In the past much harm has been done in various industries by a variety of short-sighted restrictive measures introduced by the trades unions. Federations of employers have often been too small and weak to resist new rules which they have been aware would injure their particular industry. We know, that is, that many years ago the workers in industry organised themselves on a national scale. This organisation of labour placed great and unexpected power in the hands of the trades unions, and this power has not always been wisely used. Labour has had the enormous advantage of having spokesmen representing a whole industry, while the correspouding employers have continued divided and working in only partly representative associations. Accordingly very inexperienced trades union leaders have been able to impose their will in what has sometimes proved an unjust way. We must not forget that in the general strike organised labour felt itself strong enough to try a fall with the Government itself, with complete disregard for the general welfare of the country. The present form of the dole, and other sops for the so-called " working man " which have been provided so recklessly by recent governments, are so many admissions of the power of fully organised labour. It seems to me, and in this I may be mistaken, that if heads of industry are to bargain with labour on equal terms, they, too, must organise by means of rationalisation.

In negotiations with the Government, also, a rationalised indnstry gains greatly by being able to speak with a unanimous voice. We may expect, for example, that when rationalisatiou has become more widely accepted in this country, industry may succeed in resisting the present excessive and unfair taxation. While industry remains disorganised Governments will probably contiuue to be wildly extravagant, but when rationalisation becomes fairly complete industry will be a force in national affairs that can no longer be ignored. Perhaps we shall see the day when representative business men will take the management of the country into their own hands, and all politicians will be banished into retirement.

The final form of rationalisation may be of an international character, with each State producing the things it is most fitted to do, although for the time being each nation is trying as far as possible to maintain its economic independence. Already, however, rationalisation is being arranged on an international basis, cases in point being the artificial silk industry, and the manufacture of such different products as red lead and electric bulbs.

In our own country rationalisation has been an unqualified success in every instance about which I have any information. To take the Imperial Chemical Industries, Ltd., as a prominent example, we were told in a recent speech of Lord Melchett that the company had accumulated reserves of over £16,000,000 in the short term of three years, and that not only was the concern making very rapid progress in industries which were largely foreign preserves before the war, but that they were advancing also on quite new fronts with the help of their research staff.

In conclusion may I express the hope that any mistakes or misconceptions on my part will not obscure the value and importance of this interesting subject.

NEW FERTILISER PLANT IN QUEBEC.

The new fertiliser plant of Canadian Industries, Ltd., at Beloeil, 15 miles east of Montreal, was opened formally on October 21, thus inaugurating the manufacture of superphosphate in eastern Canada. Although a number of plants intended for the manufacture of phosphate and other fertilisers are now under erection in Canada, the manufacture of superphosphate prior to the opening of the Beloeil plant, is believed to have been carried on in Canada only by the Triangle Chemical plant of Canadian Industries, Ltd., at New Westminster, B.C. Canadian Industries, Ltd., is at present operating a plant at Hamilton, Ontario, for the production of mixed fertilisers for the Ontario market, and a new plant is being erected there at which superphosphate will be produced.

LARGE VARIETY OF CHEMICAL PRODUCTS.

The concern Canadian Industries, Ltd., the head Office of which is at Montreal, has branches throughout Canada and is engaged in the manufacture of paints and varnishes, explosives and ammunition, fabrikoid and pyralin, heavy chemicals, ammonia, fertilisers and salt. The Company has embarked on a comprehensive programme for the manufacture and distribution of fertilisers on a large scale to fill the growing demand of farmers in eastern Canada. A similar programme of development is being carried out for western Canada by the Consolidated Mining and Smelting Company of Canada, Ltd., which is erecting a large new plant at the Tadanac smelter at Trail, B.C.

SEVENTY YEARS AGO.
(From the Chemical News, Feb. 11, 1860)

TECHNICAL CHEMISTRY.

On a Continual Indicator of the Specific Gravity of Gas, by Drs. J. BOSSCHA *and* L. C. LEDOIR, *Leyden University.*

Several gas-engineers may have felt the want of an instrument of simple construction to determine by an easy experiment, the more or less valuable qualities of gas issuing from different kinds of coal, and from coals of the same kind subjected to different degrees of heat.

Considering that the lighting power of gas, according to the experiments of Clegg and others, corresponds directly to its specific gravity, we tried a series of experiments with apparatus based on the principle just explained, but of different constructions, and at last succeeded in devising an instrument answering all the conditions required.

This appartaus simple in its application, may perhaps be found useful in gasworks. Its construction may be easily conceived by the following indications: A glass balloon having a volume of about half a litre (=30 cubic inches=1 wine pint) is hung at one end of a balance with an inflected beam, such as used for ascertaining the weight of letters. The accuracy and sensibility of this balance must be so great that variations in weight of one milligramme (=0.01 English grain) make themselves visible on the circular scale, over which the longest downward inflected end of the beam moves.

The whole apparatus is placed under a glass vessel, having an in- and outlet for the coal-gas, and standing in a pneumatic trough.

It will easily be understood that if the vessel is filled with gases of different specific gravities at the same degree of heat and pressure, the beam of the balance will assume a different position, and each position will correspond to a different specific gravity of gas. Our scale is divided into equal degrees and their value fixed by filling the vessel first with pure hydrogen and afterwards with air. The weight of the glass balloon must be as low as possible; the one we made use of had, together with the hook, a weight of no more than 45 grains.

It seems not difficult for micro-chemical glass apparatus makers to blow balloons of the proportions just described, but they have the disadvantage of being very fragile.

THE APPLICATION OF GROUP THEORY TO THE QUANTUM DYNAMICS OF MONATOMIC SYSTEMS.

In *Reviews of Modern Physics*, Vol. 2, July, 1930, pp. 305-380, Professor Carl Eckart gives a report on the theory of groups titled as above. One or two extracts from this report will be of interest, but the original must be studied deeply as it is of an advanced nature being mathematical in development as is necessary.

* * * *

This report is intended to furnish an account of so much of the theory of groups and their representations as has been found useful in the solution of quantum dynamical problems. The general theory (Part I) is general only in comparison with the applications which follow. This is evident in the treatment of Schur's lemma, which is proven for a very special case, mathematically speaking, but with quite sufficient generality for the purpose of quantum dynamics.

The greater portion of the report is taken up by applications to the theory of complex atomic spectra. It has seemed better to limit the field of application and to use the available space for a fairly detailed account of some problems, rather than to draw a few general illustrations from each of several fields. This may lead the reader to form a false estimate of the applicability of the methods; it may merely be mentioned that they have also been applied to the theories of molecular spectra, valence forces, electron conduction, and ferromagnetism.

* * * *

Physical considerations regarding the necessity and possibility of an exclusion principle. It must be accepted as one of the most fundamental conclusions of modern physics that all electrons are identical. They have no distinguishing features, as have the planets of the solar system; each has identically the same charge, the same mass,—in short, when two electrons are placed in identical environments, they are acted on by the same forces and behave in the same manner. This fact may be expressed in terms of the wave-function: according to the quantum theory, $\psi\psi^*$ is the distribution function of a statistical ensemble of dynamical systems. If each of these contains N electrons, then $\psi' = P\psi$ (cf. Section 18) represents another ensemble differing from the first only in that the electrons have exchanged places. This second ensemble must be physically indistinguishable from the first ensemble.

* * * *

The Pauli exclusion principle and normal multiplets. The Pauli exclusion principle was derived from a detailed consideration of the empirical material obtained from observation of the spectra of complex atoms. It states that in a given atom, no two electrons are in the same state. Two electrons may be in states having the same principal, azimuthal, and magnetic quantum numbers, but then their spin vectors must be oppositely directed. If their spins are parallel, at least one of the three other quantum numbers must be different. No real exception to this rule has ever been observed. It may be shown that this principle is equivalent to excluding the symmetric representation and retaining the antisymmetric representation as the only one having any physical significance.

F. H. L.

GENERAL NOTES

ALLIED CHEMICALS' EXTRA STOCK DIVIDEND.

AMERICA'S LARGEST CHEMICAL CONCERN.

Allied Chemical and Dye Corporation, the largest chemical company in the United States, to-day declared an extra stock dividend of one-twentieth of one share of common upon the common shares outstanding.

This dividend is payable to stockholders of record December 11 on January 3, 1931, or as soon thereafter as approval is given to list additional shares on the New York Stock Exchange.

The Company also declared the regular quarterly dividend of $1.50 per share on the common stock, payable February 2, 1931, to stockholders of record January 15, 1931, together with the regular quarterly dividend of 1¾ per cent. on the preferred stock payable January 2 to stockholders of record December 11.

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Under Section 26, Subsection 3, of the Copyright Act, 1911, an Order-in-Council was made on October 27, 1930, extending the provisions of the Act to the Irish Free State.

Copies of the Order may be seen in the Patent Office Library, 25, Southampton Buildings, Chancery Lane, London. W.C.2.

COAL, IRON AND STEEL PRODUCTION IN FRANCE, GERMANY AND THE UNITED STATES.

France.

The aggregate *coal* production in September showed an increase over each of the three previous months and was exceeded this year by the output of January, March and May only. The rate of *pig iron* output was further contracted in September; the tonnage produced daily, which averaged 26,270 tons for the month, as against 26,820 tons in August and 27,680 tons in September, 1929, was the lowest recorded since January, 1928. Furnaces in blast at the end of September numbered 140, as against 143 at the beginning of the month and 156 a yead ago. The aggregate September pig iron output (788,130 tons) included 27,550 tons of forge and Bessemer iron, 117,090 tons of foundry, 617,910 tons of basic, and 25,580 tons of other descriptions of pig iron. The total tonnage of *steel ingots and castings* made in September was, with the exception of the June production, the lowest so far returned this year.

Germany.

The returns for September show that there was some expansion of *coal* output over the three previous months. The production of *pig iron* and of *crude steel*, however, continued to contract. Per calendar day the make of *pig iron* in September averaged 21,410 tons, as compared with 36,410 tons in September, 1929. Furnaces in blast at the end of September numbered 69, a reduction of five as compared with the beginning of the month, and of 37 since the end of September, 1929. The September aggregate tonnage (642,370 tons) included 106,630 tons of foundry and hematite (including direct castings), 415,490 tons of basic, and 120,250 tons of ferro-alloys. The production of *steel ingots and castings* during the month averaged 30,810 tons per working day, as against 33,930 tons in August, and 48,570 tons in September, 1929. The production of *finished steel products* in September (26 working days) was 567,680 tons, as compared with 609,900 tons in August (26 working days) and 894,410 tons in September, 1929 (25 working days).

United States.

The aggregate September *coal* output (39,219,000 tons) included 34,493,000 tons of bituminous and 4,726,000 tons of anthracite coal. The bituminous tonnage was the highest recorded since February last, but that for anthracite was reduced as compared with each of the two previous months, and was the third lowest aggregate returned this year. The bituminous production averaged 1,363,000 tons daily in September (25.3 working days), as against averages of 1,225,000 tons in August (26 working days), and 1,657,000 tons in September, 1929 (24.3 working days). The corresponding daily averages for anthracite were 189,000 tons, 213,000 tons and 253,000 tons. Further shrinkage in the production of *pig iron* and *crude steel* was indicated by the figures for September. The September output of pig iron, which was at the rate of 75,890 tons daily, as compared with 81,420 tons in August, and 116,590 tons in September, 1929, was the smallest since September, 1924, when it averaged 68,440 tons. The number of furnaces in blast at the end of September was 123, eighteen furnaces having been blown out or banked during the month, and two blown in; furnaces in blast at the end of September, 1929, numbered 205. The *steel ingot* production in September represented an average daily output of 110,310 tons, which was the lowest average recorded since September, 1924, when it was 108,760 tons. The tonnage made in August (26 working days) averaged 119,050 tons daily, and in September, 1929 (25 working days) 181,120 tons.

GAS-WORKER WAR HEROES.

Commemoration Service at Southwark. (London) Cathredral.

A Service in Commemoration of the 386 co-partners of the South Metropolitan Gas Company who lost their lives in the War was held at Southwark Cathedral on Monday, December 6.

During the War, 3,744 employees of this one company joined the colours, and in addition to those killed, more than 1,000 were wounded. At the outset of hostilities the South Metropolitan Gas Company gave a lead to other large industrial firms by announcing that any employees joining the colours would be reinstated on their return from the War.

Proceedings and Notices of Societies

THE PHYSICAL SOCIETY.

Friday, December 5.

The following papers were read :

A Point of Analogy Between the Equations of the Quantum Theory and Maxwell's Equations. By M. Fahmy.

It is known that there is a close analogy, exhibited by the use of five-dimensional tensor notation, between the electromagnetic equations in free space and the first- and second-order equations of the quantum theory. In the present paper an analogy is traced between two tensors, one of which is related to the magnetic and electric moments of a doublet while the other represents the electric and magnetic field-strengths.

Sources of Illumination for Ultra-Violet Microscopy. By B. K. Johnson, F.R.M.S.

The paper describes experiences encountered in an attempt to find means for reducing the exposures hitherto necessary in ultra-violet microscopy. Amongst the subjects dealt with are quantitive measurements of the relative intrinsic brightness of spectrum lines given by various sources of radiation; methods of producing a monochromatic source suitable for this work; the steadiness of the illuminant; the effect on the definition of the image when a triple spectrum line is used as a source; the study of electrical conditions for the production of increased brightness of a spark, such as the effects of change in frequency, secondary potential, capacity, and energy input; and the production of a compact and inexpensive electrical unit for use with the ultra-violet microscope.

The Influence of the Crystal-Orientation of the Cathode on that of an electro-deposited Layer. By W. A. Wood, M.Sc.

The influence of the crystal-orientation of a cathode on that of an electro-deposited layer in studied by X-ray methods for copper and nickel, respectively, deposited on rolled copper. The conditions of cathode-surface and current-density which accompany an oriented deposit are determined. The orientation of the copper deposit for small currents is the same as that of the cathode. The nickel, at low current-densities, assumes a distinct orientation. As the current is increased their is a region of no orientation followed, at still higher currents, by one exhibiting the same orientation as that of the cathode surface below.

Relations Between the Fundamental Physical Constants. By C. A. Kloss, B.Sc., A.I.C.

The numerical values of the fundamental physical constants have been expressed in forms all of which involve, exactly or approximately, the quantity 10-13, and some possible inferences from these values have been suggested.

A demonstration of some stroboscopic effects were given by Professor G. B. Bryan, D.Sc., Royal Naval College, Greenwich.

GEOLOGICAL SOCIETY OF LONDON.

November 19, 1930.

The following communications were read :

The Dartmoor Granites : their Genetic Relationships (with 80 Analyses by Dr. H. F. Harwood and Assistants). By Alfred Brammall, Ph.D., M.Sc., D.I.C., F.G.S.

This complex of differentiated types comprises an ' early ' granite suite (sodi-potassic) and a ' late ' suits (potassic). They enclose relics of an older differentiated suite (sodic) ranging from granodiorites to granites (with porphyries) and including terms which approximate to Rosenbusch's ' average alkali-granite.' These cognate inclusions are distinguished from hornfelsed xenoliths (shales and diabases). Biotites and orthoclase-phenocrysts ' vary ' in the same sense as the granites themselves.

The variation-curve for the whole complex show no feature that is inconsistent with a basaltic parentage (*cf.* the Katmai, Mull, and Lassen Peak series). Biotitic varieties most nearly approaching aphanites are in almost linear variation-relationship with Devon and Cornish spilites. The sodic character of the oldest suite, the relatively high content of iron-oxides and titanium in the main granites, and the composition of the biotites (titaniferous and transitional to lepidomelane) also suggest spilitic affinities.

Contrary to expectations based on phase-equilibrium, the phenocrysts of the older main granites contain in solid solution a norm-plagioclase which is more albitic than the average for the containing granites. This anomaly (with some others) and the further fact that these coarse granites are the richest in accessory species suggest the effectiveness of crystal-accumulation, as postulated by Bowen.

Contamination is general ;hybrids are described. By the selective assimilation of potassic shales, magma-residuum was locally augmented by the substance of late-phase species, whereas cordierite and its associates persisted as solid phases. The shale-equivalent of cordierite, assessed in terms of the aureole-shales, ranges from 3 to 6. The cordierite of one garnetiferous hybrid is the most ferruginous on record ($FeO : MgO = 1.5$). Certain highly biotitic vein-facies are considered to be drafts from depth-residuum; whereas graphic granite and its allies probably represent mesostatial fluid, of low consolidation-temperature, expressed by filter-press action induced by compressional stresses.

The Palælithic Deposits of the Lower Thames Valley. By HENRY DEWEY, F.G.S.

Recent work near Swanscombe (Kent) has revealed some facts of interest with regard to the relationship of the Thames deposits to Palæolithic Man.

The deposits of the 100-foot terrace in the old pit at Milton Street are still being extensively worked. They are upwards of 30 feet thick, and are divisible into three beds of candy-gravel, Lower, Middle, and Upper, separated one from the other by beds of marly loam; and they rest upon a clean-cut surface or ' shelf ' of Chalk and Thanet Sand at a level of 88 feet above O.D.

In the Lower Gravel large cores and the flakes struck from them are present, but no true hand-axes : the associated fauna includes *Elephas antiquus* and *Rhinoceros leptorhinus*. The upper part of this gravel and the base of the loam contain freshwater and land mollusca, the most important species peing *Theodoxia crenulata* and *Corbicula fluminalis*. In the Middle Gravel sharp-edged hand-axes of early Acheulean form are common, and in the upper part of this gravel white, patinated, twisted ovate occur in an adjacent pit.

Correlation between the deposits at Milton Street with those at Ingress Vale is thus established. A newly opened pit, ' Rickson's,' about half a mile east of Milton Street pit, has also yielded the above-mentioned fauna from lower gravel in association with the large cores and flakes, while the overlying gravel contains early Acheulean and the higher gravel white patinated late Acheulean forms. The origin of a number of pyramidal masses of stony clay, and their relationship to the shell-beds, is discussed.

Evidences of aggradation of these deposits and of the Crayford brick-earth are considered, and the relative position of the Levallois industry of the Southfleet pit to those of Milton Street and to the Coombe Rock is dealt with. Some finely executed hand-axes from the Greenhithe brick-earth and the deposit in which they occurred are described : they are of late Acheulean and early Levallois aspect, and compare with the Caddington implements. Mention is made of the probable place of these deposits in the Pleistocene succession of the Lower Thames Valley.

SOCIETY OF GLASS TECHNOLOGY.

Wednesday, November 12, 1930 (joint Meeting with the English Ceramic Society, at Stoke-on-Trent.)

The Structure of Glasses : The Evidence of X-ray Diffraction. By J. T. RANDALL, H. P. ROOKSBY AND B. S. COOPER.

A number of clear glasses showing no visual signs of devitrification had been examined by means of X-rays, for evidence of incipient crystallinity. The general conclusion was that many glasses do consist of extremely small crystals, the order of size being 10^{-6} to 10^{-7} cm.

Vitreous and amorphous silica consisted largely of cristobalite crystallites of size about 1.5 to 2.0×10^{-7} cm. The distribution of particle size was not simple. The crystallites probably consisted of at least two groups, one having a much bigger average size than the other.

Wollastonite glass in all probability consisted of crystallites of pseudo-wollastonite, the hexagonal crystal formed at high temperature, and of the same order in size as the vitreous silica crystallite. Sodium borate glass consisted of small crystallites of $Na_2B_4O_7$.

A commercial hard glass containing 10 per cent. SiO_2, and 17 per cent. B_2O_3, was found to contain a large proportion of the silica as cristobalite crystallites. The presence of cristobalite crystallites in a glass depended upon the nature of the oxides other than silica, rather than on the proportion of silica present. One glass of percentage composition 70 SiO_2, 17 Na_2O, 5 CaO, 4 MgO, gave an X-ray pattern quite different.

The oxides of boron and aluminium did not appear to combine with silica, whereas the oxides of the strongly electro-positive elements calcium and sodium did, thereby destroying the silica lattice.

Strained and unstrained glasses gave *identical patterns.*

The authors regarded the term "amorphous" as having little meaning. Amorphous bodies and glasses were both really crystalline.

A Method for the Measurement of Plasticity of Clays, and Some Applications. By E. J. C. Bowmaker, B.Sc.

The method of Dr. K. Pfefferkorn was slightly modified and applied to the determination of the plasticity of many and varied samples of clay.

The plasticity of a clay paste was described as the ability of the particles to slide over one another, or the inverse of the shearing stress set up. The relationship between the "deformed height," and the grams of water used in mixing the 100 grams of clay was shown graphically, the former units being ordinates. The curves obtained were to all intents and purposes straight lines. There was considerable variation in the slope in some cases, the mean distances of the curves from the "X" axis differed. Denoting the intersection of a curve with the lower X axis by R, and that of the curve with the upper X axis by r, the plasticity was expressed by $P = R(R - r)$.

By the application of this formula to the results on the deformation of plaster cylinders of various clays and mixtures, values of P were obtained generally in the order which practical experience indicated. Hence the method would seem to be worthy of more extensive use in investigating the property of plasticity.

Specifications for Tank Blocks. By W. J. Rees, B.Sc.Tech., F.I.C.

Mr. Rees examined the *Provisional Specification for Glassworks Refractories*, as prepared in 1919 by the Refractories Committee of the Society of Glass Technology in the light of the greater amount of useful data and experience now available. In regard to tank blocks the experimental and practical evidence of the last ten years had probably shown that the recommendation to use aluminous clays had been a sound one. In general, the experience under the intensive modern methods of glass production in tank furnaces had confirmed the advantage of the use of clays of high alumina content. Possible exceptions might arise in tanks melting glasses rich in boric acid. prepared from natural sillimanite, cyanite, or andalusite, or synthetic mullite emphasised the effect of "mullite" content in promoting chemical resistance.

The "Recommendations and Suggestions" appended to the *Specifications* had been very helpful in that they had aroused much criticism and discussion. The suggestions with regard to the methods of use of tank blocks had been largely adopted by glass manufacturers.

A Standard Specification and its concomitant Standard Methods of Testing which would be internationally acceptable to glass and refractories manufacturers was a conclusion worth striving for.

Notes on the Casting of Refractories. By W. Emery.

Consideration was given to two main classes of slip, namely, (1) those containing fairly high proportion of large grained non-plastics, such as are used often for the making of gas retorts, and (2) those in which the non-plastics are in moderately fine grains. Experiments undertaken by the author to explore the possibility of casting horizontal fireclay gas retorts were described, the work embracing both the laboratory and the works sections. The effects of various deflocculants on the suspending power of the slip, and modifications of the blunging process were tested. Soda silicate 100° T, and soda carbonate were used as liquifying agents in the laboratory tests and later, a mixture of these two materials in the ratio of 2 : 1 was used as deflocculant in the large scale work. Finally retorts measuring 5ft. by 2ft. 4in. by 2ft. were cast, dried, and burned satisfactorily. Tests made in different laboratories on portions cut from a specimen showed a maximum variation of 0.8 per cent. in porosity, and a maximum difference of 0.03 per cent. in the after-contraction.

This experimental work showed that, using alkaline deflocculants only, it would be possible to produce goods in many respects superior to those obtained from the same maxes, hand moulded; and that when the upper limit of grog content possible with plastic pressing was reached, the casting process enabled further additions of non-plastics to be incorporated and if need be, they could be of much larger size.

The author was assured that for certain designs of saggars used in the sanitary trade, casting was cheapest. The process also found use in the production of supporting slabs, and certain intricate sections of combustion zones of tunnel kilns.

ROYAL INSTITUTION.

At a General Meeting of the Members of the Royal Institution held on Monday afternoon (December 1), Sir Robert Robertson, Treasurer and Vice-President, in the chair. Lord Eustace Percy was unanimously elected President of the Institution in succession to the late Duke of Northumberland. The thanks of the Members were returned to Major C. E. S. Phillips, Secretary, for his gift of a water colour of the Royal Institution by T. Hosmer Shepherd; to Mr. R. W. Paul, M.R.I. and Mr. R. S. Whipple, M.R.I. for their present of auxiliary Projection Apparatus for the Lecture Theatre; to Mrs. Tyndall, M.R.I. for a silver-plated inkstand, formerly the property of Michael Faraday, and to Mr. L. Rome Guthrie, M.R.I. for Japanese paper for the Ambulatory and for the restoration of early plans of the Institution. Mr. Angus Blue, Mr. P. Dunsheath, Mrs. Frizell, Miss Pomeroy and Professor A. M. Tyndall were elected Members.

CORRESPONDENCE.

SIR WILLIAM POPE'S ADDRESS.

(*To the Editor of* THE CHEMICAL NEWS.)

Sir,—In your issue of November 28 (pp. 338-341) there is a full account of Sir William Pope's address on "Science in Modern Industry," delivered before the British Science Guild. Towards the end of this address an attack is made on the science teaching in schools. Sir William states that he finds students entering the university already equipped with a sufficient knowledge of theoretical organic chemistry to pass the honours degree exam. which they are to take some years later. He then goes on to contrast their linguistic abilities with Dutch students, apparently unmindful of the fact that men of science belonging to a small nation must of necessity acquire a good knowledge of foreign tongues. The *Receuil de Travaux chimiques des Pays-Bas* contains articles in German, French and English, but *not* Dutch.

If students arrive at Sir William's laboratory equipped with such a knowledge of organic (and presumably inorganic) chemistry, which they can only have acquired during their last years at *school*, he *should* surely be grateful to the science masters who have taught them so excellently, thus saving him much preliminary work.

I am, yours, etc.,

SCIENCE MASTER.

NOTICES OF BOOKS.

Wanderings in Czechoslovakia. By J. G. F. DRUCE, M.Sc., R.Nat.Dr., F.I.C. Pp. 110, with 32 plates and map. London: Williams and Norgate, 38, Great Ormond Street, W.C. 1930. Price 7s. 6d.

This interesting book gives the author's impressions of the many places in Czechoslovakia that he has visited in the past ten years. It contains, moreover, much that will attract the general public and especially the scientific reader, for Dr. Druce begins by outlining the history of the country and its people, stressing here and there its more significant contributions to scientific knowledge and general progress.

In succeeding chapters the author gives an account of Prague, its environs, the Bohemian Forest, the Thermal Resorts, East Bohemia and then goes on to describe the main characteristics of Moravia, Silesia, Slovakia, and Sub-Carparthian Russia. Among the features that will appeal especially to visitors, mention may be made of the unique thermal springs such as those of Karlsbad and Marienbad, the radium mines of Jachymov (St. Joachimsthal) the many castles and their association with the mediæval alchemists (*e.g.*, that of Krivoklat where Edward Kelley was imprisoned in the fifteenth century by Rudolf II).

In a different way the stalactite-stalagmite caves near Brno in Moravia and at Demanova in Slovakia, the ice caves at Dobsina and the remarkable geysir at Herl'any form another series of natural features of unusual character and which are described and mostly illustrated in the present work. Those who have visited the country will welcome the appearance of this book, whilst those who are contemplating a visit to Central Europe will find it indispensable.

Czechoslovakia receives annually thousands of English-speaking visitors and this volume, which is the outcome of twenty visits, should appeal especially to those who go to the spas, to the various business fairs, or to any of the many congresses that are held in this conveniently-situated and charming country.

Agricultural Research in 1929. Issued by the Royal Agricultural Society of England. Pp. 182. London: John Murray. 1930. Price 1s. 3d., post free.

Farmers are at a disadvantage not only in interpreting the results of scientific work, but also in knowing where to look for them. They appear in periodicals not always accessible to the farmer and couched in language not always easily understood by him. His work lies around him on this farm; he has neither the time nor the means to study a multiplicity of journals and pamphlets, and thus it happens that the results of research work are often too slow in reaching those most concerned. Collected from all available sources, put together by acknowledged authorities, in non-scientific language, the contents of *Agricultural Research* should be studied by all those who wish to keep themselves abreast of the times in modern agricultural practice.

In "Crops and Plant-breeding," Professor Engledow has provided an interesting summary of the development of winter washes for fruit trees derived from tar oil. The way in which these washes act as destroyers of eggs of injurious insects is still uncertain, but of their effectiveness as winter washes there is no doubt, and their use may even dispense with the necessity for spring spraying in some orchards. For the arable farmer there are useful articles on varieties of sugar beet, and on the control of rust and smut disease of cereals. Mr. Mackintosh deals with questions of interest to the dairy farmer, and milk producers will give special attention to the section of his article on "Dairy Husbandry," dealing with the intensive manuring of grass land, even though it may require a good deal of courage in these days to lay out money on the intensification of production. The economic aspects of milk production are considered also in Mr. Orwin's article entitled "Agricultural Economics," where the question of the utilisation of surplus milk is discussed. In these days of low prices and high costs the question of the use of machinery on the farm is one of increasing importance, and some figures are given of cultivation costs with the use of a tractor, which farmers may compare profitably with their own horse labour costs. Following on the same subject, farmers should find much of interest to them in Dr. Owen's article on "Agricultural Engineering."

Agriculturists all over England will read with sympathetic appreciation Dr. Crowther's note on the work of the late Professor T. B. Wood, which introduces his article on "Animal Nutrition." Farmers in general and bullock-feeders in particular, owe a deep debt of gratitude for his lifelong services to the industry. Other sections of this article to which attention may be directed are those on the value of sugar beet pulp as a cattle food, and the feeding value of potatoes. As in past years, Sir John Russell's notes on "Soils and Fertilisers" form one of the most important sections of the volume. It is satisfactory to read that the production of artificial fertilisers, particularly of nitrogenous manures, continues to expand, and in spite of economic difficulties it seems that the cheapness of chemical fertilisers is making them increasingly attractive to farmers.

Readers of the article on "Veterinary Science will note with regret that the name of Sir John McFadyean is no longer associated with it. Whilst regretting his retirement, after a long life devoted to the service of agriculturists, a welcome must be extended to Dr. F. C. Minett, Director of the Research Institute in Animal Pathology, whose first contribution deals with many matters of primary importance to the practical farmer. Amongst these, further experience is recorded of progress in combating that scourge of the cow-keeper, contagious abortion.

For the assistance of students and others desirous of consulting original sources of information, each section of *Agricultural Research* concludes with a complete bibliography of papers quoted. The Royal Agricultural Society, it should also be noted, is continuing the sale of the volume at the reduced price of 1s. 3d., post free, in order to secure the widest possible circulation.

LIVINGSTONE COLLEGE, LEYTON, LONDON.

The Report and account of the above for 1929-30 shew that the useful activities of the College have been well maintained. It is pleasing to note that the College met its expenses of the year out of income and also materially reduced the deficit accumulated last year.

Forthcoming Events.

ROYAL SOCIETY OF ARTS.

John Street, Adelphi, John Street, W.C.2.

Friday, December 12, at 4.30 p.m.—(Indian Meeting) "India's Commercial Fibres." By Alfred Wigglesworth.

ROYAL INSTITUTION.

21, Albemarle Street, W.1.

Tuesday, December 9, at 5.15 p.m.—"Stellar Structure and the Origin of Stellar Energy." By E. A. Milne, M.A., M.Sc., F.R.S.

Thursday, December 4, at 5.15 p.m.—"The Agricultural Development of the Empire. (I.) Reclaiming the Wastes. (II) Conquest of the Drought." By Sir John Russell, D.Sc., F.RS..

Saturdays, December 6, and 13.—"Persia and the Persians. (I) The Country and its History. (II.) Art and Literature." By Sir E. Denison Ross, C.I.E., Ph.D.

THE INSTITUTE OF METALS.

SHEFFIELD LOCAL SECTION.

Friday, December 12, at 7.30 p.m.—"Studies in the Electrodeposition of Silver. Throwing Power. The Behaviour of Silver Anodes, with special reference to Blackening and its Prevention." By H. D. Blacklie. M.Sc., and A. E. Nicol.

MANCHESTER CHEMICAL SOCIETIES.

THE SOCIETY OF DYERS AND COLOURISTS.

Friday, December 12, at 7 p.m., in the Lecture Room of the Lit. and Phil. Society, 36, George Street—

"Theories of Lustre." By J. M. Preston, B.Sc., A.I.C.

"Notes on the Iodine Mercerisation Test." By W. F. A. Ermen, M.A.

OIL AND COLOUR CHEMISTS' ASSOCIATION.

Friday, December 12 at 7 p.m., at the Royal Institution, Liverpool.—"The Incorporation of Dry Pigments into the Medium." By Mr. A. W. C. Harrison.

INSTITUTE OF RUBBER INDUSTRY.

Thursday, December 18, at 7 p.m., at "The Manchester Ltd." Royal Exchange.—"The Use of Concentrated Latex in the Rubber Industry." By J. H. Carrington, B.Sc., A.I.R.I.(Sc.).

ROYAL INSTITUTE OF PUBLIC HEALTH.

Wednesday, December 17, at 4 p.m., in the Lecture Theatre of the Institute, 37 Russell Square, London, W.C.1.—"The Prevention of Industrial Diseases." By Prof. Edgar L. Collis, M.A., M.D., M.R.C.P.

GEOLOGICAL SOCIETY OF LONDON.

A Special Meeting of the Society will be held on Dednesday, December 17, at 5.30 p.m., to authorise the retirement upon pension of the Permanent Secretary on December 31, 1930, in accordance with the scheme authorised by the Council on May 14, 1930. The Ordinary General Meeting will be held immediately after the Special General Meeting.

ROYAL MICROSCOPICAL SOCIETY.

An ordinary meeting of the Society will be held in the Hastings Hall at the Society's new premises, B.M.A. House, Tavistock Square, London, W.C.1., on Wednesday, December 17, at 5.30 p.m. The following papers will be read and discussed:—

"Observations on Pond Life, with Special Reference to the Possible Causation of Swarming of Phytoplankton." By S. C. Akehurst, F.R.M.S.

"A New Top Light Illuminator." By J. M. Preston, B.Sc., A.I.C., F.R.M.S.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

34,543.—I. G. Farbenindustrie Akt.-Ges. —Bleaching with acid chlorine solutions. November 17.

34,568.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of carbon from acetylene. November 17.

35,118.—I. G. Farbenindustrie Akt.-Ges. —Apparatus for purifying concentrated nitric acid. November 21.

35,169.—I. G. Farbenindustrie. Akt.-Ges. —Manufacture of derivatives of higher fatty acids containing nitrogen.

338,240.—I. G .Farbenindustrie Akt.-Ges. —Manufacture of amino-diphenylamine compounds.

338,412.—Soc. of Chemical Industrie in Basle. — Manufacture of anthraquinone derivatives.

335,062.—Methyl alcohol.—Dreyfus, H., 22, Hanover Square, London.

Specifications Published.

In the production of methanol from carbon monoxide and hydrogen, the reaction gases are passed first over one or more masses of zinc oxide with or without chromium oxide, and then over one or more methanol catalysts which are sensitive to sulphur poisoning such as catalysts containing copper or manganese or their compounds. The process may be effected in an open system, *i.e.*, not in a closed circuit. In an example water gas or the like is passed at 50-100 atmospheres pressure through a number of reaction chambers containing zinc oxide, while the later chambers contain for instance a mixture of copper and zinc oxides. The reaction gases are treated to remove the methanol produced. If desired a sufficient number of reaction chambers may be used to cause the conversion of practically all the gas mixture into methanol. Four or five chambers are usually sufficient.

Printed copies of the full Published Specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2., at the uniform price of 1s. each.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

BONDERITE.

516,935.—Chemical substances in class 1 for use in conditioning metal surfaces preparatory to enamelling. — The Pyrene Co., Ltd., Great West Road, Brentford, Middlesex. November 26.

ZALCOL.

516,483.—Chemical substances used for agricultural, horticultural, veterinary and sanitary purposes.—Newton. Chambers & Co., Ltd., Thorncliffe Ironworks and Collieries, near Sheffield. November 26.

GRAMMAR OF LOGIC.

100 Questions and Answers on The Grammar of Logic or How to Reason Correctly. By J. E. Roscoe, M.A., Oxon.

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By the Rev. J. E. Roscoe, M.A.

This striking work gives extracts (with comments) from the opinions of 50 great writers and thinkers in all ages on Religion. These include Bacon, Balzac, Burns, Carlyle, Cicero, Dante, Darwin, Dickens, Emerson, Faraday, Homer, Huntley, Johnson, Longfellow, Maeterlink, Milton Napoleon, Newton, Pope, Ruskin, Shakespeare, Socrates, Spenser, Thoreau, Wordsworth, etc., etc.

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THE CHEMICAL NEWS

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NOTICE TO AUTHORS & CORRESPONDENTS

Contributions for publication either as original articles or in the correspondence columns are welcomed by the Editor of *The Chemical News*.

They must be accompanied by the contributors' full names and addresses, not necessarily for publication, but as an indication of good faith. If a reply is needed or if it is desired that a manuscript which is not accepted for publication be returned, a stamped addressed envelope should be enclosed.

No notice can be taken of anonymous letters.

POLAROGRAPHIC STUDIES WITH THE DROPPING MERCURY CATHODE. — PART XIII. — THE EFFECT OF PROTEINS.

By PROFESSOR J. HEYROVSKY AND DR. J. BABICKA.

(*Continued from page 371.*)

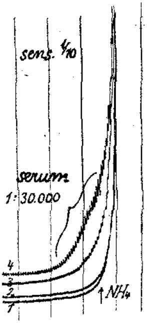


Fig. 7.

1. pure 0.146 n. NH_4Cl, 2. with serum 1 : 300.000, 3. with serum 1 : 100,000, 4. with serum 1 : 30.000 in hydrogen atmosphere.

Next a set of phyto-albumins was examined, their solution being prepared by aqueous extractions of flours from grains of maize, barley, wheat, peas, beans, Brazil nuts, rice, etc., and added to a solution of 0.02 n. NH_4Cl and LiCl. The flour was always finely ground, suspended in water (1 gr in 50 ccs.), shaken and allowed to stand for half an hour, the solution filtered and added to 20 ccs. of the ammonium-lithium chloride solution. Usually a few ccs. when added, caused a " wave." Further other liquids which contain albumins, were similarly examined, like milk, beer, and urine. Also agar showed a distinct " protein wave," even without ammonium addition. The results will be found in the Table and in Fig. 5A and B.

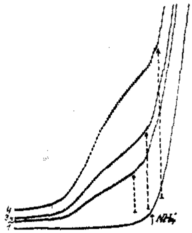


Fig. 5A.

1. pure 0.02 n. NH_4Cl, 0.146 n. NaCl; added :
2. 0.50 cc., 3. 1.0 cc., 4. 2.0 cc. of 2 per cent. milk solution to 10 ccs. Sens. $^1/_{300}$

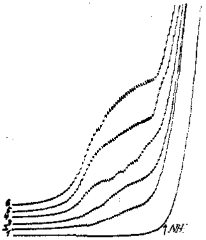


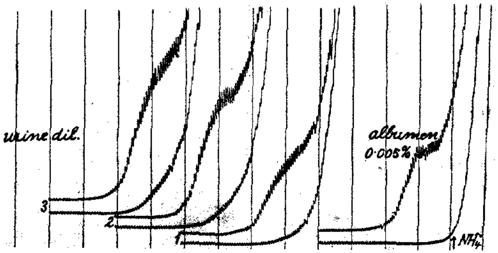
Fig. 5B.

1. pure 0.02 n. NH_4Cl, 0.146 n. NaCl; added : 2. 0.5 cc., 3. 1.0 cc., 4. 2 ccs. 5. 5 ccs. 6. 10 ccs. of 2.5 per cent. beer solution to 10 ccs. Sens. $^1/_{300}$.

TABLE.

Albuminous substance	Percentage of substance in solution	Height of the "albumin wave" in cms., with sensit. $^1/_{300}$	Percentage of albumin calculated from the "wave"	Percentage of albumin total known to be
White of egg	0.1%	10cms	12.50%	14%
,, ,,	0.03	4	15	
Human serum	0.1	4	5	
,, ,,	0.2	8	5	5
,, ,,	0.008	0.1*	4	
Crystalline egg-albumen	0.005	7	(ca 140)	100
Cow's milk, raw	0.4	6	1.9	
,, ,, boiled	0.2	3	1.7	2.5
Beer (Plzen)	1.25	5	0.4	0.3-0.6
Flour from beans	0.05	3	7.5	
,, ,, peas	0.05	1.5	4	ca 30
,, ,, wheat	0.05	3.5	8.5	13
,, ,, maize	0.3	2.5	1.5	10
,, ,, rice	2	0.04*	0.03	6
Urine (albuminous)	1	3.5	0.5	0.4
Agar (pulv., Merck)	0.15	2.5	0.6	?

* "Waves" observed with a larger sensitivity, recalculated for sens. $^1/_{300}$.



1. lower curve :	2 ccs. of	10 % normal	urine added to	20 ccs.	0.146 n. NH_4Cl
upper ,,	2 ,,	10% albumin	,, ,,	20 ,,	0.146 ,, ,,
2. lower ,,	2.5 ,,	10% normal	,, ,,	20 ,,	0.146 ,, ,,
upper ,,	2.5 ,,	10% albumin	,, ,,	20 ,,	0.146 ,, ,,
3. lower ,,	3.0 ,,	10% normal	,, ,,	20 ,,	0.146 ,, ,,
upper ,,	3.0 ,,	10% albumin	,, ,,	20 ,,	0.146 ,, ,,

Sens. $^1/_{100}$.

The calculation of the percentage of albumin was based on the assumption that the 4 cm. "wave," observed with the sensitivity 1/300 in the 0.1 per cent. solution of human serum indicates 5 per cent. albumin, and that the content of albumin is proportional to the height of the "wave." Thus the 0.1 per cent. solution of white of egg, which gives a 10 cm. "wave," is regarded as 12.5 per cent. This refers to soluble albumin only.

To find the content of albumen in urine the liquid was ten times diluted by 0.146 n. NH_4Cl and this solution added by ½ cc. to 20 ccs. of the pure solvent (see Fig. 6. Plate IV); the same was made with normal *urine and with a 1 per cent. solution of* human serum in the same solvent (0.146 n. NH_4Cl). Thus it was found that equal additions of 1 per cent. serum or 10 per cent. urine caused "waves" of the same height; the content of albumen in urine is thus ten times smaller than in serum, *i.e.*, the urine contains 0.5 per cent. albumen. The approximate "Esbach" test gave a 0.4 per cent. content of albumen in this pathological urine.

Organic substances which do not contain any proteins were found to give always a negative test of the "protein wave." Of these were investigated : glycocol, asparagin (as mentioned further below), cellulose, starches, sugars, fats, oils, higher alcohols, fatty acids, all of which did not show the least tendency to cause a deformation of the ammonium "wave" in the manner that albuminous substances do. In solutions, which showed the "protein wave" when freshly prepared, the effect gradually decreased with the time, as the proteins were decomposed; this was most marked when the solutions were kept at room temperature, especially when artificial putrefaction was induced; in those kept at 0° C. the "protein wave" remained constant when curves were repeated after several days.

To find in what dilution the "protein wave" is still discernible, freshly obtained human serum was diluted by 0.146 n. NH_4Cl in the ratio of 1 to 10.000, 50.000, 100,000 and 300.000; thus diluted solutions were freed from air by bubbling through them hydrogen over-night at a temperature slightly below 0° C. The polarogram Fig. 7 shows that the curve due to the serum diluted 1 : 100.000 still bears the "protein wave" (3 cms., with $^1/_{10}$ sensitivity); this is the ordinary limit of sensitivity of the polarograph estimation, considering that the content of albumen in serum is only ca 5 per cent. The height of the "protein wave" in this solution is proportional to those obtained in the solutions diluted 1 : 1000.

Since the proteins consist chiefly of long-chain amino-acids, additions of simpler amino-acids were tried to solutions of ammonium salts, to *examine whether they* could produce "albumin effect" on the current-voltage curve. From these glycocol, asparagin and lecithin were used, however without the least effect. Thus only the undecomposed albumins seem to be able to produce the "wave" effect on the deposition current of ammonium or amines.

On many polarograms the "protein wave" appears to consist of two waves; this distinction is more pronounced in phyto-albumins (comp. Fig. 1, where the second wave is denoted by an arrow).

It is, of course ,expected that in the process of electro-reduction only the most soluble kind of proteins can be involved, *viz.*, sero albumin, egg-albumin, milk-albumin and phyto-albumins; the insoluble ones, like globulins, other proteins and proteids are excluded in this action. This would explain the discrepancy in the results concerning the albumin content in seeds (see the Table) : The percentage of albuminous content estimated by ordinary analysis of the total amount of nitrogen is certainly much larger than that of the soluble phyto-albumins; the greatest discrepancy is found in rice flour, which shows the least content of the albumins to which the "wave" is supposed to be due.

Additions of a 1 per cent. solution of purest gelatine (D. G. F. "sans odeur") does not show any distinct wave, although this substance is known to contain complex

albuminous matter; it has been, however, observed that gelatine suppresses the "albumin wave" when added to solutions containing albumin. On the other hand a solution of agar, saturated cold and still more on warming, shows the presence of albumin to about 0.006 per cent (ca 1 per cent. in the solid agar); this is ascribed to traces of phyto-albumin contained in agar.

THE THEORY OF THE "ALBUMIN WAVE."

Since the increase of current due to proteins is furnished by a part of the current due to the deposition of ammonium ions, which takes place at a more positive potential, the theory of the "protein wave" must be based upon the mechanism of the electro-reduction of ammonium ions and that of amines.

The view may be adopted that the increase of current due to ammonium ions is really furnished by the deposition of hydrogen ions from the system of equilibrium

$$NH_4^{\cdot} \rightleftarrows H^{\cdot} + NH_3 ;$$

this cathodic process would yield hydrogen and ammonia, which indeed are known to be the products of the electro-deposition of ammonium ions. From this point of view the deposition—or rather decomposition—of ammoniumm ions consists merely of the deposition of hydrions from a complex ion of hydrogen, $NH_3.H+$; such a deposition from complexes has to take place at a potential the more negative the more firmly the ion is bound to the complex (comp. the deposition of cadmium[2] or manganese[3] from ammoniacal solutions). The deposition of hydrions from a normal solution occurs at about -1.1 v., that from a normal solution of ammonium ions at -1.7 v.

If now the ammonium ions associate with the molecules of proteins, A, adsorbing to them, compounds of the sort $A.NH_3.H^{\cdot}$ are formed, in which the binding between the hydrion and ammonia is loosened. Such more loosely bound hydrions of adsorbed ammonium ions must be consequently deposited more easily, *i.e.*, at a more positive potential; the deposition from these adsorbed ammonium ions thus has to cause on the current-voltage curve a "wave" before that due to free ammonium ions.

The same mechanism of reaction may be extended to the amines or amino acids which were found to promote the "protein wave."

[2] M. Dobryszycki, *Collection*, 1930, 2, 184.

[3] J. Brezina, *Rec. Trav. Chim.*, 1925, 46, 520.

The stoichiometric relationship between the amount of proteins and ammonium ions, which, according to the theory given, seem bound together as $A.NH_3.H^{\cdot}$, is in the case of egg-albumen 1 gr of ammonium to 4 or 5 grs albumin. Since the albumin molecules are enormously great against those of ammonia, many ammonium ions must be imagined to join one particle of the albumin.

The authors thank Professor B. Nemec, Director of the Institute of Plant Physiology, for his suggestive interest in this research.

SUMMARY.

It has been found that current-voltage curves obtained polarographically with the dropping mercury cathode arrangement reveal the presence of proteins in solutions. If ammonium salt be added to a solution containing albuminous matter, an increase of current is observed at a potential about 0.2 v. more positive than that due to the deposition of ammonium ions. In excess of ammonium ions the height of the "wave" on the current-voltage curve due to proteins reaches a limit, which is proportional to the content of the soluble albumins (serum, egg, milk, and phyto-albumin).

The presence of soluble proteins in solutions of blood-serum, flours from various seeds, milk, beer and urine becomes thus noticeable even in traces of 0.0001 per cent.

From the Physico-chemical Institute
and the Institute of Plant
Physiology, Charles University,
Prague.

(*From Collection of Czechoslovak Chemical Communications.*)

MERCHANDISE MARKS ACT, 1926.

The Standing Committee (General Merchandise) appointed by the Board of Trade have reported on their enquiry as to whether imported fertilizers and feeding stuffs of the following descriptions should be required to bear an indication of origin :—

(*a*) Bone meal and bone flour whether raw, degreased or degelatinised;
(*b*) Hoof meal, horn meal and mixtures thereof;
(*c*) Meat-meal, meat and bone meal and carcase meal;
(*d*) Dried blood, whether ground or unground.

The Report will shortly be obtainable from the Stationery Office, either directly or through the usual channels.

AN IMPROVED BODE'S LAW AND THE TRANS-NEPTUNIAN PLANETS AND THE ORIGIN OF THE SATELLITES.—PART III.

By F. H. Loring.

It will be seen on examining Fig. 1A (*Chemical News*, 1930, *141*, 337) with a magnifying glass that the body or bodies of the upper curve, on the line of Jupiter, where the more massive bodies presumably lie, are nearer to Saturn than those lower down are to the other planets respectively. Owing to the very elliptic orbits postulated for these bodies, one may have brushed near to Saturn—may have come within Roche's limit—and have suffered partial or complete disruption into small fragments which formed Saturn's rings; the particular spacing (gaps) of these rings being brought about by the gravitational field resulting from the influence of Saturn as a whole and modified by its satellites, a problem which was mathematically solved by G. R. Goldsbrough. The rotating system is disposed in its parts to comply with the dynamic stability as influenced by the gravitationally acting masses. The gaps in the ring system would be zones of instability for the particles, this being due to the influence of the satellites thereon.

Saturn has probably the most massive satellite of all the satellites except Jupiter's moon, Ganymede, and probably Neptune's nameless moon, as might be expected from the material at the source being of greater mass as judged by the parallelism with Jupiter, as stated above.

Saturn has but one retrograde satellite, so far definitely discovered, that might appear to have originated from the group higher up (see Fig. 1A), but this group seems too far away for a capture—even allowing for a very elongated orbit—unless widely scattered, so that there may be a small planetary body (or bodies) at the place indicated, having a mean distance from the sun of about 13 astronomical units, assuming of course, that the two curves are near to the truth in representing planetary distances and satellite formations.

Uranus shows, according to Fig. 1A, a close intersection, so that its four satellites were of easy capture according to the view here developed; but perhaps these (or one), being of small mass, were not pulled to pieces to such an extent as to supply sufficient material for rings as in the case of Saturn. Very faint rings, sparsely populated, might be there and they may be ultimately revealed by more powerful telescopes than at present built.

The position of Uranus seems to suggest that the satellites should all be retrograde in their movement according to the arrow system shown on Fig. 1A. That is to say, they were drawn in on the *top* side. These retrograde satellites seem to afford support to the capture theory as distinguished from the theory of tidal action as a replica in miniature of the one which gave birth to the planets in general.

Neptune with one large satellite, about the same distance off as our moon, presents a difficulty, but it may have been formed in the same general way that our moon is supposed to have originated; *i.e.*, parted off from the earth owing to a coincidence in its natural period of vibration with its tide-periodicity, thereby causing disruption, but this process seems obscure. The tide-generating body in the case of Neptune was the departing star which had drawn out filaments from the sun; the planets, as then represented, in turn having condensed into the bodies as now known, as Jeans has so ably expounded in his works (see, for example, his THE UNIVERSE AROUND US, 1930, 1st or 2nd Edn.). This makes the two extremes of the solar system similar in this way, but otherwise quite different as may be judged by the spacing of the values associated by the two curves of Fig. 1A.

Coming to the asteroids, the present-day opinion seems to be that a large planet once existed between Mars and Jupiter, which came within the disruptive influence of Jupiter (Roche's limit) and was broken up; Mars' two satellites being captured asteroids (Jeffreys), and no doubt Jupiter captured some or many. Our moon shows evidence of an asteroidal bombardment (see Moon's Surface, Loring, *Chemical News*, 1925, *131*, 177-179). The breaking up of this planet there, may have been the cause of so many small bodies. There are now 1091 asteroids definitely recorded or mapped, but in all there are thousands, but all too small to make up a planet of very appreciable mass. Perhaps one approaching the mass of Mars would be the biggest possible from the materials present in the wide zone where these bodies abound. What there may have been initially we do not of course know.

According to Jeans' theory of the origin of the planetary system as based partly on earlier views (see, for example, those of Chamberlin and Moulton) the matter issuing

from the sun should, before condensing into planets, be piled up in the middle like a fat cigar, Jupiter's material being about midway. This would demand a planet of considerable mass, corresponding to, say, Uranus, or even one bigger, to occupy the place taken up by some of the asteroids, while Jupiter may be abnormally large owing to captured bodies; still Mars seems rather small as a next planet, so that some extensive catastrophe may have occurred. We speak about the passing star in the singular, but such a star might have been double or have had a few planets of its own before entering our region of space as then considered, and one of these bodies might have collided with a big planet next to Jupiter, or have cut through the filament at this point and so have destroyed the regularity of the system on one side of Jupiter.

Considering this irregularity Russell, Dugan and Stewart in their ASTRONOMY (1926) page 350 of vol. I say:—"Seven-eighths of them [asteroids], however, have mean distances lying between 2.3 and 3.3 astronomical units, and, therefore, periods between $3\frac{1}{2}$ and 6 years.

"The average of the mean distances of the asteroids bearing the numbers 1-807 is 2.805, almost exactly that indicated by Bode's law [2.8]. For the larger ones, which are bright enough to stand a good chance of being observed even if near the outer limits of the group, the average is 2.91, and this is probably nearer the true mean.

"The mean distances are not distributed at all uniformly through their range. There are several marked gaps, doubtless due to the action of Jupiter, since they come just where the period of the asteroid would be exactly commensurable with that of the great planet, that is, $\frac{1}{2}$, $\frac{1}{3}$, $^2/_5$, $^3/_5$, etc. of Jupiter's period.

"Curiously enough, the few asteroids whose periods are more than seven years seem to follow the opposite rule, and to cluster round the distances corresponding to periods $\frac{2}{3}$ and $\frac{3}{4}$ of Jupiter's or to Jupiter's period itself."

CHEMICAL SOCIETY'S LIBRARY,

BURLINGTON HOUSE, LONDON. W.1.

The Library of the Chemical Society will be closed for Christmas Holidays from 1 p.m. on Tuesday, 23rd December until 10 a.m. on Monday, 29th December.

COMBINED POWER AND HEATING.

A NOTABLE PAPER AT THE WORLD POWER CONFERENCE.

By A WELL-KNOWN ENGINEER.

There seems little doubt that the present principle in Great Britain of devoting the main attention as regards national power supply to the erection of huge superpower stations with condensing steam turbines, for the supply of electricity by long distance overhead tranmission lines, is not providing the cheapest current in all cases. The inherent disadvantage of this method is that the latent heat of steam is not utilised, with the result that 60 per cent. of the total heat of the coal is lost in the cooling water of the condenser. Thus about 9,000,000 tons of coal per annum are consumed in public supply electricity stations, and say 5,500,000 tons of this coal is merely used to raise the temperature of about 4,000,000,000 tons of cooling water per annum, on the reasonable estimates of 450 tons of cooling water required per ton of coal. All this vast volume of water has to be pumped, and in many cases costly cooling towers are also required because the available river is not large enough, while the thermal efficiency of the average electricity station is 15-20 per cent. from the raw coal to the switchboard.

The fact that more and more attention is now being concentrated on this important subject is well illustrated by a uoteworthy paper "Combined Heat and Power Supply in Industrial Plants" that was read by W. F. Ryan (American Society of Mechanical Engineers) at the recent Second World Power Conference in Berlin. Essentially it is admitted in the paper that many industrial establishments, of which chemical works are a good example, requiring heating steam, can generate electricity cheaper than any power station with condensing steam turbines by using back-pressure or pass-out engines or turbines, which in average cases prevent most of the latest heat or steam loss so that the thermal efficiency is say 50-65 per cent. This is rendered all the more evident in the United States because of the enormous progress that has been made during the past half dozen years with high pressure industrial steam. Thus Ryan states that in 1929 steam at 300 lbs. pressure or over was being used on 141 Ameri-

can industrial plants, of which 139 had been erected since 1924. Also the paper emphasies that a huge increase in steam pressure say from 400 lbs. to 1,200 lbs. in an electricity station only gives say 10 per cent. increased thermal efficiency, a relatively small item compared with the loss in the condensing. The paper by Ryan is essentially a plea for closer co-operation between industrial plant and power stations, so that the latter can sell both electricity and exhaust steam. Obviously from a theoretical point of view this is on correct lines, although not always possible to carry out, and the proper policy in most countries is to develop to the fullest extent the individual steam power and heating plant in many different industries, nearly 100 in number, requiring low pressure process steam, using the heat in the exhaust steam after generating power.

There is of course nothing new or untried in the matter, and for example Belliss and Morcom, Ltd., of Birmingham, have erected nearly 1,500 installations both engines and turbines, many of which are in the chemical dyeing, paper, and sugar refining industries. The best plant to use, whether back-pressure or pass-out, depends upon the individual conditions, and for example Ryan states in his paper that when the power demand is large in proportion to process steam a reciprocating engine is better than a turbine, but two of the main points of the principle are flexibility and equal suitability for large and small plants, using either engines or turbines.

£16,000 GIFT TO THE ROYAL INSTITUTION.

The Royal Institution has received an intimation from the Pilgrim Trust that the Trustees have allocated the sum of £16,000 to meet the deficiency on the fund for the reconstruction of the Institution. The Trustees state that, in making this grant, they had regard to the distinguished scientific services rendered to the whole community by the Royal Institution for over a century, and to the approaching Faraday Celebrations. They were also not unmindful that the founder of the Royal Institution, Count Rumford, was of American origin.

ITALIAN PHARMACEUTICAL INDUSTRY.

The pharmaceutical industry is of considerable importance as a branch of Italian chemical trades, and more especially in the post-war years it can point to important achievements in securing which many obstacles had to be overcome.

This special branch of the chemical trades falls into two main groups : that or ordinary pharmaceutical and medicinal products sold by weight and used by chemists in making up prescriptions and by chemico-pharmaceutical laboratories in the preparation of specialities ; and that of medicinal specialities so called because they comply with certain special requisites, each being a specific for a certain illness. This latter branch follows in the wake of therapeutical progress, and includes a whole category of biological products consisting of sera, vaccines, opotherapic preparations, ferments, etc.

The chemico-pharmaceutical industry can be said to date back its origin to certain old-fashioned specialities made up by doctors and others, and even by religious orders, on the basis of pharmaceutical formulae of recognised curative value, some of which still enjoy the confidence of the public.

The production and trade in medicinal specialities may be said to have begun with these preparations in the XVII century.

But it was in the XIXth century, when the several branches of the chemical industries were first organised, that chemico-pharamceutical production acquired its special characteristics thanks to the efforts of bold innovators. It was then that the utilisation of certain medicinal salts was begun on a large scale, followed by the distillation of certain plants for the extraction of vegetable mericines, and this gradually led to the opening of specialised factories for the preparation of the many medicines required by modern therapeutics.

Preparation in large quantities made it possible to supply the products on favourable terms ; the importance of the dispensaries atached to chemists shops gradually declined, and the chemico-pharmaceutical industry progressed steadily, improving its equipment and extending the field of its labours.

In 1911 there were 388 medicinal product factories in Italy, employing 8,831 persons.

In 1927 the industrial census returns show that the number of concerns engaged in this business had risen to 426, employing 9,755 workers.

Data supplied by the National Fascist Federation of Chemical and Allied Industries, to which is affiliated a special group of manufacturers of pharmaceutical products and medicinal specialities, show that the Italian chemico-pharmaceutical industry represents a capital investment of some 300 million lire, with a total annual output valued at over 350 million lire, of which 200 to 220 million are accounted for by medicinal specialities. over 10 million by sera and vaccines, and the remainder by other pharmaceutical products.

The workers engaged in this branch of industry, *inclusive of those occupied in the* preparation of products only partially used for therapeutic purposes, number in all some 10,000, of whom about 1,000 are one the clerical and managerial staff.

The output capacity of the Italian plants is greatly in excess of their actual production, and the introduction of a few technical improvements and a slight increase of staff would allow of doubling the present output.

Pharmaceutical products.—This is the most important branch of the business as it provides the products required for the preparation of those medicinal specialities in which the largest trade is now done.

The industry uses natural raw materials from which it secures its products by refining and mixing salts, distilling medicinal essences from plants, and obtaining from their several parts extracts containing their curative virtues and preserving their characteristic qualities. Besides the salts and alcaloids properly described as chemico-pharmaceutical products, this branch of the industry also prepared the pure chemical products required for analysis and research, and the whole category of synthetic products complying with the requirements of specific formulæ and possessing specific curative powers.

Twenty years ago *all the pure chemical products needed for analyses and scientific purposes were imported.* Since the war the preparation of these delicate products has been introduced into Italy and we can now safely say that for almost the whole gamut home production suffices for the needs of the home market.

Great and essential progress has been made in the field of *chemico-pharmaceutical production* : iodine and all its inorganic and organic derivatives are now manufactured in Italy not only for home consumption but also for export. Until recently iodine was practically the world monopoly of the nitro-sodium syndicate of Chile; it has been extracted in the last few years from the waters (*acque madri*) of the Salsomaggiore baths in quantities exceeding the needs of the home market.

Bromo, all of which was until recently imported, is now extracted from the *Margherita di Savoia* salts and all its derivatives are prepared by the Italian pharmaceutical industry, as are also the whole of the constantly growing series of preparations for radiological purposes.

The basic alkaloids—morphia, codeine, acetylmorphia, caffeine, teobromine, etc., are also prepared in part by the home industry. So also are the several salts of glycerophosphates, cacodilates, methyl-arsenates, citrates, formiates, the Italian products comparing satisfactorily with similar preparations coming from foreign laboratories.

Anæsthetics in general—chloroform, sulphuric ether, etc.—are also prepared in quantities exceeding home demands. Their quality and freedom from impurities is guaranteed not only by chemical but also by strict physiological tests.

Italy obtains more than half the quinine she requires from the Dutch in the form of sulphates; the Italian government plantations at Java supply the remainder. All quinine salts (hydrochyoride, dihydrochloride, sulphate, bisulphate, etc.) are now prepared by the home industry and in the Government laboratories. A plan is now being studied and will soon be carried out for the reorganisation of quinine production and distribution, which will radically transform the present situation and make Italy independent of foreign supplies as regards this essential medicine.

The manufacture of *synthetic products* has assumed marked importance of late years. The derivatives of salicylic acid, acetylsalicylic acid, phenyl salicylate, sodium salicylate, etc., are now prepared by the Italian pharmaceutical industry along with guaiacol, etherial salts, benzoic acid and its derivatives, amino-antipyrine, diethylmalonylurea, etc.

The list of chemico-pharmaceutical preparations made in Italy is a formidable one; the quantities are however frequently small as such medicines are generally administered in small doses and consequently an

output of a few score kilograms suffices for the needs of the home market.

The number of chemico-pharmaceutical factories is not large but their equipment is thoroughly up-to-date and their preparations have made a name for themselves abroad as well as at home. It is not easy to draw a rigid distinction between the chemico-pharmaceutical factories and those preparing medicinal specialities as many of the larger concerns manufature both. Moreover some of the large chemical works also manufacture medicinal products.

Among the more important producing centres we must mention Milan, Turin, Bologna, Florence and Rome.

Of recent years the leading concerns have not only improved and enlarged their plants but they have also improved their technical processes by standardising and mechanising the laboratories.

As a result, output has steadily increased. This is shown by the following table giving, for 1921 and 1928, particulars for the output of the leading chemico-pharmaceutical products prepared in Italy. The data are taken from the Yearbook of the Chemical and Pharmaceutical Trades, 1928, published by the Ministry of Guilds (*Ministero delle Corpoazioni.*)

ITALIAN CHEMICALS IN 1928.

	Kilograms
Refined boric acid	1,833,500
Commercial carbolic acid ...	150,000
Formic acid	440,000
Lactic acid	800
Salicylic acid	35,000
Arsenobenzols	370
Acetylsalicylic acid (asprin)	6,000
Benzoates	7,130
Bircarbonate of soda	2,452,000
Bromo	7,800
Bromides	4,450
Cacodylates	255
Caffeine and salts	1,580
Citrates (exclusive of citrate of lime)	22,570
Refined cream of tartar ...	1,800,000
Dermatol...	3,100
Elmitol	3,400
Esamethylentetramine (urotropine)	24,000
Ethyl ether	166,200
Formates	61,900
Glycerophosphates	41,440
Unrefined iodine	4,600
Bisublimated iodine	4,000
Iodides	6,580
Lactates	4,250
Lecitine	2,800
Mannite	238,000
Methylarsenates	640
Morphia, salts and derivatives	65
Nitrate of silver	13,700
Nitrate of bismuth	3,300
Salicylicates	8,835
Quinine salts	15,265
Mercury salts	62,235

GENERAL NOTES

Sir E. RUTHERFORD ON PAINT AND MODERN CIVILISATION.

SIR ERNEST RUTHERFORD, president of the Royal Society, speaking at a luncheon on November 19, of the Research Association of British Paint, Colour and Varnish *Manufacturers, said the association had* done as much in its four and a half years of existence for the British industry as its counterpart in the United States had done in 20 years.

That industry was much older than many of them thought, and they were probably not aware how much their industry had been responsible for modern civilisation. A distinguished friend of his, an anthropologist, once informed him that the use of paste paints by the ladies was really responsible for the modern scientific age. In explaining that theory his friend said they had definite evidence that the ladies at the dawn of Egyptian civilisation adorned their features with a paint made from malachite. It was easy to understand how some husband might have become irritated with his wife's adornments and thrown some malachite into the fire. Hence the copper and bronze age! At a later age women were addicted to the use of rouge, and when rouge was thrown into a charcoal fire iron would result. Hence the iron age! That line of argument might be fanciful, but there was one thing of which they were certain—that the origin of their industry was based on scientific knowledge.

If there was a time when manufacturers should adequately support the scientific side of their work it was surely in a time of difficulty like the present. There would be

fiercer competition between the nations of the world in industry, and it was the nation that applied scientific methods most successfully that would succeed.

At a subsequent meeting of the association a resolution was carried that the association should be carried on for a further period of five years.

KEY INDUSTRIES.

Representations have been made to the Board of Trade under Section 10 (5) of the Finance Act, 1926, regarding acid isobutyl allyl barbituric; butyl methyl adipate; calcium gluconate; quinoline; strontium carbonate and stronium nitrate.

Section 10 (5) of the Finance Act, 1926, is as follows :—

"The Treasury may by order exempt from the duty imposed by section one of the Safeguarding of Industries Act, 1921, as amended by this Act, for such period as may be specified in the order, any article in respect of which the Board of Trade are satisfied on a representation made by a consumer of that article that the article is not made in any part of His Majesty's Dominions in quantities which are substantial having regard to the consumption of that article for the time being in the United Kingdom, and that there is no reasonable probability that the article will within a reasonable period be made in His Majesty's Dominions in such substantial quantities."

Any communication should be addressed to the Principal Assistant Secretary, Industries and Manufactures Department, Board of Trade, Great George Street, S.W.1, within one month from the date of this notice.

THE SLAGGING GAS PRODUCER.

The Ontario Research Foundation has prepared a report under the direction of Mr. C. Tasker, Research Fellow in Fuels, dealing with the Georgsmarienhuette type of slagging gas producer. The report is based on development work in Germany. This generator may be considered as a small or semi-blast furnace in which part of the carbon monoxide produced is used to reduce the ferruginous flux. The chief dimensions are :—height, about 16¼ ft.; width, 3ft. 6ins. to 10 ft., giving a capacity of 100 metric tons per 24 hours for the large size. The packet of the generator is water-cooled, and pre-heated air at 65 to 70°C., at a presure of about 16 ins. of water is applied by a ring of tuyeres. Iron is tapped at the bottom and slag about 8 inches higher. The gas produced is reasonably constant, and from a ton of fuel of carbon content 80 per cent. there is obtained about 140,000 cubic feet of gas measured at 0°C at 760 mm. The generator is essentially a coke-operated slagging or dry-gas producer. A flux, consisting of mixer slag or basic Martin's slag or a combination of the two, with or without slag rich in iron from other sources, is used to flux the coke ash. The raw iron produced is high in manganese and phosphorus. The iron recovered from fluxing slag, amounting to 2,860 pounds, was 95 pounds.—*Canadian Chemistry and Metallurgy.*

LONDON'S 40,000-TON "BLANKET" OF SOOT.

Sir H. Llewellyn Smith's Plea for Smokeless Fuel.

Nearly 40,000 tons of soot and dirt are deposited every year on the surface of the City of London. This fact is revealed by Sir Hubert Llewellyn Smith, formerly Chief Economic Adviser to the British Government, in a plea for the more general use of smokeless fuel, which he makes in his newly-published survey, "London Life and Labour."

Sir Hubert declares that, while the amount of atmospheric pollution is gradually declining, thanks largely to the increased use of gas and other smokeless fuel, it is impossible to rest satisfied with the present situation.

It is the poorer people who suffer most, he states, as the incidence of the deposit is greatest in the most congested areas.

"Grime," adds Sir Hubert, "is one of the worst foes of the amenities of our life, and it means also heavy and constant toil for the over-burdened housewife."

MARKET FOR POLISHES AND DRESSINGS IN TURKEY.

A confidential report on the market for polishes and dressings in Turkey has been prepared by the Department of Overseas Trade from information furnished by the Commercial Secretary, His Majesty's Embassy, Istanbul, and issued to firms whose names are entered on its Special Register.

United Kingdom firms desirous of receiving a copy of this report together with particulars of the Special Register service of information and form of application for registration should communicate with the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1, quoting reference D.X. [illegible]

Proceedings and Notices of Societies

THE CHEMICAL SOCIETY.

Thursday, December 4.

Nitrogen Tri-iodide. By H. W. CREMER AND D. R. DUNCAN.

Nitrogen tri-iodide of the composition indicated by the formula NI_3 can be prepared by the action of dry ammonia on solid iododibromides, *e.g.*, 4 NH_3+3 $KIBr_2$ =3 KBr+NI_3+3 NH_4Br; 4 NH_3+3 $CsIBr_2$ =3 CsBr+NI_3+3 NH_4Br; 4 NH_3+3 C_5H_5N, $HIBr_2$=3 C_5H_5N, HBr+NI_3+3 NH_4Br. In the last case a further reaction occurs, *viz.*, C_5H_5N, HBr+NH_3=C_5H_5N+NH_4Br, so that the complete change may be written as follows: 7NH_3+3 C_5H_5N, $HIBr_2$=3 C_5H_5N, +NI_3+6 NH_4Br. It is probable that the mechanism of the reaction is as follows:—3 $KIBr_2$=3 KBr+3 IBr; 3 IBr+NH_3= 3 HBr+ NI_3; 3 HBr+3 NH_3=3 NH_4Br. The more stable iododibromides, *viz.*, those of very low dissociation pressure, do not react with ammonia to form nitrogen tri-iodide, but form instead additive compounds with two molecules of ammonia, *e.g.*, $(CH_3)_4NIBr_2(NH_3)_2$.

The experimental data indicate that the reactions proceed according to the above equations, and that the insoluble residue left on rapidly washing with water the product from the potassium salt contains nitrogen to iodine in the atomic ratio 1 : 3.

From preliminary experiments it seems that nitrogen tri-iodide can be sublimed in a vacuum at room temperature, the sublimate being condensed by means of liquid air.

The Synthesis of Chrysanthemin Chloride. By S. MURAKAMI, A. ROBERTSON AND R. ROBINSON.

The action of acetic anhydride on the disodium salt of ω-3 : 4-trihydroxyacetophenone furnishes ω-hydroxy-3 : 4-diacetoxyacetophenone, isolated by means of its calcium chloride compound.

The tetra-acetylglucoside of this keto-alcohol condenses with O-benzoylphloroglucinaldehyde in ethyl acetate solution in the presence of hydrogen chloride yielding a *flavylium* salt which gave cyanidin chloride 3-β-glucoside on debenzoylation and de-acetylation.

The synthetical anthocyanin was found to be identical with chrysanthemin chloride.

The Four Isomeric β-glucosides of Pelargonidin Chloride. By A. LEON, A. ROBERTSON, R. ROBINSON, AND T. R. SESHADRI.

The 3-β-glucoside (callistephin chloride) was identified as the anthocyanin of red carnations (variety, " Spectrum "). The 4′-β-glucoside has been similarly prepared starting from O-benzoylphloroglucinaldehyde and ω-4-dihydroxyacetophenone. The 5-β-glucoside offered much more difficulty than the other isomerides but ultimately a small amount was obtained from O-dibenzoylphloroglucinaldehyde by introduction of the tetra-acetylglucone residue followed by hydrolysis and condensation with ω-4-dihydroxyacetophenone. The properties of the 5-β-glucoside tally with those of pelargonenin chloride (Willstätter and Bolton). It is the only one of the four isomerides that gives a fluorescent alcoholic solution.

These results throw light on the problem of the constitution of pelargonin chloride and are discussed in relation to Karrer's work on the methylation of that anthocyanin and of monardein.

A Synthesis of Oenin Chloride. By F. L. LEVY, T. POSTERNAK, AND R. ROBINSON.

O-Acetylsyringoyl chloride and diazomethane afford a *diazoketone*, AcO$(MeO)_2$ C_6H_2.CO.CHN_2, which yields a *formoxy*-derivative, AcO$(MeO)_2C_6H_2$.CO.OCHO, on treatment with absolute formic acid, and this is hydrolysed by prolonged refluxing of an aqueous alcoholic solution to the ω-hydroxyketone,

AcO$(MeO)_2$.C_6H_2.CO.CH_2OH.

Alternatively the diazoxyketone directly.

The *tetra-acetylglucoside*, AcO$(MeO)_2$ C_6H_2.CO.CH_2.O.$C_6H_7O(OAc)_4$, from this condensed with O-benzoylphloroglucinaldehyde in ethyl acetate solution in presence of hydrogen chloride and the product gave malvidin chloride 3-β-glucoside after hydrolysis and regeneration of the flavylium salt.

This synthetic anthocyanin was found to be identical with oenin chloride (Willstätter and Zollinger) prepared from purple-black grapes, and it is probably identical with primulin chloride (Scott-Moncrieff).

SOCIETY OF PUBLIC ANALYSTS.

An ordinary meeting of the Society was held at the Chemical Society's Rooms, Burlington House, on Wednesday, December 3, the President, Dr. J. T. Dunn, being in the chair.

Certificates were read for the first time in favour of Kenneth Bullock, M.Sc., Ph.D., and Frederick Cecil Hymas, B.Sc., A.I.C.

Certificates were read for the second time in favour of Arthur Nicholls Ainsworth, B.Sc., Bertram Arthur Gough, William Henry Gough, M.Sc., A.I.C., and William Henry Shilling, B.Sc., A.I.C.

The following were elected Members of the Society :— Leonard Balmforth, B.Sc., F.I.C., Reginald Joseph Cole, B.Sc., Violet Dorothy Dudman, B.Sc., A.I.C., Frank George Edmed, O.B.E., B.Sc., A.R.C.Sc., F.I.C., Roy Gardner, D.Sc., F.I.C., William Victor Griffiths, B.Sc., A.I.C., Daoud Younis Haddad, B.Ph., Percy George Terry Hand, F.I.C., Hagnus Herd, B.Sc., A.R.T.C., F.I.C., Gilbert Underwood Houghton, B.Sc., A.I.C., Archibald Robert Jamieson, B.Sc., F.I.C., William Jefferys Lesley, M.Sc., Ph.D., A.I.C., Allison Reginald Murray MacLean, B.A., M.Sc., Ph.D., Frederick Henry Newington, F.I.C., Colin Paterson, B.Sc., A.I.C.

The following papers were read and discussed :—

A Storage and Delivery Apparatus for Antimony Chloride Solution and other Corrosive Reagents. By G. Middleton, B.Sc., A.I.C.

In this apparatus the antimony chloride solution is forced upwards by means of a compression rubber bulb into a tube fitted inside the reagent bottle, whence it passes into an external measuring tube, delivering 2 c.c. into the tintometer cell. The ground-glass joints connecting the parts of the apparatus are constructed in such a manner than the reagent does not come in contact with them, thns preventing their being cemented together by the formation of antimony oxychloride.

Tests for Impurities in Ether. Parts II and III. By G. Middleton, B. S4., A.I.C. and F. C. Hymas, B.Sc., A.I.C.

A comparison of the sensitiveness of tests for acetaldehyde and acetone is given. The colour developed with Schiff's reagent, even with the purest ether, is due to rapid oxidation of the ether during the period of the test—this reaction being catalysed by sulphur dioxide. The addition of 0.1 per cent. of pyrogallol to the reagent prevents this, while it does not interfere with the sensitiveness of the reagent towards acetaldehyde. The caustic alkali test should be superceded by a more delicate test. Nessler's reagent is a sensitive test for small quantities of acetone, but fails to indicate the presence of larger quantities. The tests recommended for official adoption are : For acetaldehyde the modified Schiff's reagent; and for acetone, the vanillin test of the Dutch Pharmacopoeia.

The Determination of small Quantities of Calcium in Magnesium Salts. By Norman Evers, B. Sc., F. I. C.

Owing the the unsatisfactory and lengthy nature of the usual methods for determining small amounts of calcium in magnesium salts, more particularly in the oxide and carbonate, the following process is suggested. Dissolve the required weight of the magnesium salt in 25 c.c. of 20 per cent. sulphuric acid, and add 50 c.c. of 95 per cent. (by vol.) alcohol. Mix thoroughly and leave overnight. Filter on a Gooch crucible and wash with 200 cc. of a mixture of 2 volumes of 95 per cent. alcohol and 1 volume of 20 per cent. sulphuric acid. Ignite and weigh as $CaSO_4$. The results obtained have a tendency to be slightly low, but are sufficiently accurate for ordinary purposes. The method may also be applied to solutions containing phosphates, iron, etc.

A New Method for the Detection of Nitro-Group in Organic Compounds. By P. K. Bose, D.Sc.

The method, which is applicable to all poly-nitro organic compounds, is based on the hydrolytic dissociation of the compound by means of potassium hydroxide, and the identification of the resulting nitrous acid by means of the Griess-Ilosvay reagent.

ROYAL AGRICULTURAL SOCIETY OF ENGLAND.

The Annual Report, passed at the meeting on December, 10th, mentions that the Society's laboratory has been made use of by members to much the same extent as in the previous year, 150 samples having been submitted as against 170 in 1929. Several matters of special importance to the farming community have engaged the attention of the Chemical Committee. One of these is the definition of "barley meal" The Society has, by the periodical reports of its Council and by deputation to the Minister of Agriculture, sought to obtain a better understanding as to what is meant by the definition "commercially pure, as grown," as set out in the Fertilisers and Feeding Stuffs Act, 1926, and applied to barley used for grinding into barley meal. Ultimately, a legal decision on the point was given on July 30th last, according to which the term shall only apply to barley "containing not more than 4 per cent. of total impurities." It is satisfactory to record

this decision, after much agitating; it is a decision which, moreover, is both fair and reasonable.

The constitution of the Advisory Committee of the Ministry of Agriculture on *the Fertilisers and Feeding Stuffs Act*, as being not adequately representative of agricultural interests, has likewise been the subject of correspondence between the Society and the Ministry.

The occurrence of castor seed in feeding stuffs has again come to the front, and cases of illness and death of stock consequent on the presence of this poisonous seed have been reported.

Prices of both fertilisers and feeding stuffs have continued favourable to the purchaser, and, there having been but little change in this respect, the Table of Unexhausted Manure Values remains unaltered.

Other matters dealt with in the Consulting Chemist's report are the continuous coming to hand of deliveries of Peruvian Guano of high quality, "Chilian" peas, drinking waters, sewage effluents, etc.

The Chemical Committee greatly regret the death of Mr. James Falconer, one of their number, who had always shown a marked interest in their work and in that of the Woburn Experimental Farm.

GEOLOGICAL SOCIETY.

J. B. Tyrrell Fund.

An Award from this Fund will be made in February 1931. The amount at present available is about £200, and applications are now invited from British and Irish geologists who propose to visit the Dominion of Canada for the purpose of study or research, and who require assistance in the payment of the necessary travelling and living expenses. Applications, to be addressed to the Secretary, should be received not later than January 14 1931, and *must be accompanied by* a statement programme intended and of the qualifications of the applicant.

Gloyne Outdoor Geological Research Fund.

The Council of the Geological Society wishes to call your attention of the Fellows to the above-mentioned Fund, the regulations concerning which are obtainable on application to the Secretary. The Fund is to be applied to the payment for actual work done in the field (excavations ,etc.), but not to the reimbursement of personal expenses. The amount of income at present available is about £200.

ROYAL SOCIETY MEDALS.

The following awards have been made this year by the President and Council of the Royal Society (with the approval of H.M. the King):

A Royal Medal to Professor O. W. Richardson, F.R.S., for his work on thermionics and spectroscopy.

A Royal Medal to Professor J. E. Marr, F.R.S., for his pioneer work in the accurate zoning of the palæozoic rocks.

The following awards of medals have also been made by the President and Council:

Copley Medal to Sir William Bragg, K.B.E., F.R.S., for his distinguished contributions to crystallography and radioactivity.

Rumford Medal to Prof. Peter Debye of Leipzig for his work relating to specific heats and X-ray spectroscopy.

Davy Medal to Prof. R. Robinson, F.R.S., for his work on the constitution and synthesis of natural products, and for his contributions to the theory of original reactions.

Darwin Medal to Prof. Johannes Schmidt of Copenhagen for his work on extended oceanographical expeditions, and for his genetic studies in animals and plants.

Hughes Medal to Sir Venkata Raman, F.R.S., of Calcutta, for his studies on the abnormal scattering of light.

The following is a list of those recommended by the President and Council for election to the Council of the Royal Society at the anniversary meeting on December 1:

Sir F. Gowland Hopkins (president), Sir Henry Lyons (treasurer), Dr. H. H. Dale, and Dr. F. E. Smith (secretaries), Lord Rayleigh (foreign secretary), Prof. E. V. Appleton, Prof. G. Barger, Prof. A. E. Boycott, Prof. E. P. Cathcart, Sir Alfred Ewing, Prof. T. S. Goodrich, Prof. G. H. Hardy, Sir Harold Hartley, Sir Thomas Lewis, Dr. W. H. Mills, Prof. E. A. Milne, Dr. A. B. Rendle, Prof. R. V. Southwell, Prof. G. I. Taylor, Prof. D. M. S. Watson, and Prof. W. W. Watts.

NOTICES OF BOOKS.

Electrochemistry.

(1) *Electrolytic Conduction.* By F. H. NEWMAN, D.Sc., A.R.C.S., F.Inst.P. Pp. xii + 441. London: Chapman and Hall, Henrietta Street, W.C. 1930. Price 25s.

(2) *The Electrochemistry of Solutions.* By S. GLASSTONE, D.Sc., Ph.D., F.I.C. Pp. xii + 476. London: Methuen & Co., Essex Street, W.C. 1930. Price 21s.

It is almost half a century since Arrhenius published his experiments on electrical conduction in solutions and put forward his theory of electrolytic conductivity. Since then much experimental data has accumulated and especially during the last decade have the earlier views been extended or remodelled in the light of recent researches. Thus, during the past few years, Debye and Hückel have formulated a theory which satisfactorily accounts for the phenomena with strong electrolytes.

The two volumes, by Prof. Newman and by Prof. Glasstone which have just been published, give admirable surveys of present knowledge and outlook in this increasingly important branch of physical chemistry. The first book is intended primarily for the physicist, but will be welcomed by all those who are interested in the conduction of electricity through electrolytic solutions. Although the work is not a text-book in the ordinary sense of the term, it is suitable for those students of physics or chemistry, who are preparing for pass or honours degrees, as well as for those actively engaged in research work in this particular branch of science.

Prof. Glasstone's work is in the nature of a theoretical textbook of electrochemistry, written more particularly for chemists. For those not conversant with the progress made by certain continental schools during the last few years, the author has included accounts of the more important researches abroad.

Among the subjects discussed are Conductance, the Modern Theory of Electrolytic Dissociation, Equilibria in Solutions, Reversible Cells, Electrometric Titration, Hydrogen Ion Concentrations, Indicators, Overvoltage, Passivity, Deposition of Metals and Alloys, Corrosion, and Electrolytic Oxidation and Reduction.

Both treatises contain copious references to original memoirs and both can be recommended to the attention of physicists and chemists.

Heterogene Katalyse. By DR. ERWIN SAUTER. Pp. x + 80, with 15 figures. Dresden and Leipzig: Theodor Steinkopff. 1930. Price 6 marks.

The recent developments in the technical application of the results of the many researches on catalysts and surface phenomena are referred to in Dr. Sauter's volume on Heterogeneous Catalysis. The importance of speeding up chemical reactions with the aid of the most convenient accelerators has led to great activity in this field of physico-chemical enquiry and it is only a matter of time before much of the data accumulated is applied industrially. Methods of preparing the catalysts, their action and the measurement of the acceleration, the influence of temperature, pre-treatment and various applications are all discussed in Dr. Sauter's useful monograph.

Dechema Monographie 12 (*Band* 2). By DR.-ING. EMIL KIRSCHBAUM. Die Verstärkung durch teilweise Kondensation binärer Gemische und ihre Berücksichtigung bei der Berechnung von Rektifizierapparaten. Pp. 46. Verlag Chemie, G.m.b.H., Berlin W10. 1930. Price 5 marks.

Nach einleitender Problemstellung werden die physikalischen Vorgänge bei der Kondensation von Dämpfen binärer Gemische beleuchtet. Auf der Tatsache fussend, dass bei der Kondensation die Temperatur von Dampf und Flüssigkeit gleich ist, sind die Ausgangsgleichungen zur Berechnung der Verstärkung durch teilweise Kondensation aufgestellt und diese zu einem Endergebnis ausgewertet. Aus diesem sind für den Fall des Gemisches Aethyl-alkohol-Wasser die Verstärkungskurven ausgemittelt und zu einem graphischen Schaubild zusammengefasst. Es geht daraus hervor, dass die verstärkende Wirkung des Kondensators praktisch eine Rolle spielt, sofern es sich um ein Gebiet handelt, in dem überhaupt noch—sei es in der Kolonne Ower im Kondensator — versuchen und von Versuchen an Betriebsapparaten liefern einen Vergleich mit den auf Rücklauf-Gegenstromkondensator in sämtlichen Versuchsbereichen eine Uebereinstimmung.

Das mit verschiedenen Abbildungen und grossen Tabellen versehene, gut ausgestattete Buch kann allen an diesem Gebiet Interessierten als wichtiger Beitrag zum chemischen Apparatewesen empfohlen werden.

Forthcoming Events.

SOCIETY OF DYERS AND COLOURISTS.

LONDON SECTION.

December 19. — "Emulsifying Agents, Textile Assistants, and Finishing Materials, their Examination and Valuation." By Dr. T. Callan.

THE PHYSICAL SOCIETY.

Imperial College of Science and Technology, South Kensington.

January 6—8, 1931.—Annual Exhibition of Electrical, Optical, and other Physical Apparatus.

THE ROYAL INSTITUTION.

21, Albemarle Street, London, W.1.

CHRISTMAS LECTURES.

The one hundred and fifth course of six lectures adapted to a juvenile auditory. Professor A. M. Tyndall, D.Sc., M.R.I., on "The Electric Spark." Tuesdays, Thursdays and Saturdays, December 30, 1930, January 1, 3, 6, 8, and 10, 1931 at 3 p.m.

ROYAL INSTITUTE OF PUBLIC HEALTH.

CONGRESS IN THE CITY OF FRANKFURT, *May* 19 *to* 24, 1931.

The next annual Congress of The Royal Institute of Public Health will be held in the City of Frankfurt-on-Main from Tuesday, May 19th to Sunday, May 24th, 1931 (Whitsuntide), on the invitation of the German Government, the Municipality and the University of Frankfurt.

The Congress will be presided over by The Most Hon. The Marquess of Reading, G.C.B., G.C.S.I., G.C.I.E., etc.

The Inaugural Meeting will be held on the morning of Tuesday, May 19th, and the scientific work of the Congress will be conducted in English in the following Sections:

Section I. "State Medicine and Municipal Hygiene."
Section II. "Architecture, Housing and Town Planning,"
Section III. "Industrial Hygiene,"
Section IV. "Women and Children and the Public Health."
Section V. "Tuberculosis."
Section VI. "Pathology, Bacteriology, and Bio-Chemistry."

Educational Visits will be paid to the chief places of interest in the City of Frankfurt, including the new Housing developments. Some of the chief Spas and Health Resorts of the Rhine and adjacent districts will be visited, including Wiesbaden, Homburk, Nauheim, Kreuznach, and Münster-am-Stein. On Saturday, May 23rd, a whole day's visit will be made to the ancient University and Town of Heidelberg.

To this International Congress delegates are being invited from the Governments, the Municipalities, the Universities, and other Public Bodies of Great Britain and Ireland and the British Dominions, as well as from Continental and Foreign Countries.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

35,344.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of adenosine triphosphoric acid. November 24.

35,604.—I. G. Farbenindustrie Akt.-Ges. — Manufacture of acetaldehyde. November 26.

35,617.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of sulphuric acid. November 26.

53,725.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of nitrogenous condensation products from acetylene and ammonia. November 27.

Specifications Published.

338,329.—Soc. Francaise de Catalyse Generalisee.—Catalytic manufacture of synthetic acetic acid.

338,566.—Caro, Dr. N., and Frank, Dr. A. R.—Production of nitric acid from ammonia.

Abstract Published.

336,282.—Formaldehyde. — (Bakelite Corporation; 247, Park Avenue, New York, U.S.A.)

In making formaldehyde by the catalytic oxidation of methanol, the formation of by-products is minimised by adding a basic agent such as ammonia to the reaction mixture at any stage or stages of the process prior to the distillation of the crude product obtained by absorbing or condensing the mixture leaving the catalysers, the basic agent being in proportion sufficient to ensure that the distillate is substantially neutral. For example, ammonia gas may be led into the pipe conveying methanol and air to the catalysers, or ammonia may be added to the crude product before distillation. Basic compounds of the alkali or alkaline earth metals may also be employed as neutralising agents either during the absorption or condensation step, or during the distillation. It is preferable to maintain the reaction mixture substantially neutral throughout the whole process.

Printed copies of the full Published Specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2., at the uniform price of 1s. each.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

DEODIS.

516,828.—All goods in class 2 which includes chemical substances used for agricultural, horticultural, veterinary and sanitary purposes.—Richard Davies, 22, Northumberland Avenue, London, W.C.2. December 8. (Associated.)

515,786.—Illustration of a dog and the word Doooo. — Chemical substances in class 2 for repelling dogs.—James Auld Rennie, 118 to 120, Fleet Street, London, E.C.4. December 8.

GRAMMAR OF LOGIC.

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SCIENCE DISCIPLINE.

By LIEUT.-COL. SIR DAVID PRAIN, C.M.G., C.I.E., M.A., M.B., LL.D., F.R.S.

The Alexander Pedlar Lecture, delivered on October 22, in the University of Liverpool.

Sir Alexander Pedler, F.R.S., was honorary Secretary of the British Science Guild from 1907 until his death in 1918; and during this period he rendered most valuable service to the Guild and the Empire by promoting attention to science and its contacts with modern life. The Alexander Pedler Lecture was established to commemorate his work and influence.

It has been suggested that the member invited by the Guild to deliver the Alexander Pedler Lecture for 1930 might, as an old Indian colleague, refer to Sir Alexander's work and influence in Bengal. Compliance involves the pleasant duty of thanking the Vice-Chancellor of the University of Liverpool and the Council of the British Science Guild for occasion to honour the memory of a friend.

The sympathetic notices of Pedler's career, suggest that he owed his selection for service in India to the early promise he gave to gaining distinction as a chemical investigator. Indian colleagues, who know what Pedler did to promote attention to Chemistry in Bengal, are not surprised to find English chemists think what Pedler did there hardly fulfilled the expectations of his contemporaries or the hopes of his teachers. But this view does not impress Indian colleagues, who remember that the duties Pedler had to perform were not the duties he was selected to undertake. He was appointed to a post likely to involve original investigation, because a Lieutenant-Governor of Bengal, with ideas in advance of

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contemporary public opinion, wished to add a competent chemist to the staff of the provincial Agricultural Department. A new Lieutenant-Governor, with other ideas, was authorised to suppress the post of Agricultural Chemist and offer Pedler employment in the Bengal Education Department as a professor in the Calcutta Presidency College. This arrangement, which Pedler accepted, improved his prospects; service in the Education Department implied possibility of promotion.

As a member of the Presidency College staff, Pedler had to face difficulties. Chemistry was already taught vocationally, in provincial technical colleges, to scholars under training for professional public service : " the state of barbarous ignorance of even the rudiments of scientific culture." which Professor Huxley found characteristic then of " mass of English Univerity men," if less evident than at home, was not unknown in Bengal. But Pedler enjoyed two compensating advantages. He had received Instruction and Discipline from teachers who shared Huxley's educational ideals : the Department to which he had been transferred was administered by a scholar who held, with Huxley, that " Science and Literature are not two things, but two sides of one thing." Under a Director in sympathy with Huxley's policy of " giving Instruction in Science as such, and with no direct reference to any of its practical applications," Pedler found no " difficulty in the way of giving proper instruction in Physical Science " : the Principal of the Presidency College sanctioned the necessary " tutorial practical instruction."

Yet neither the Director of his Department nor the Principal of his College could make the Chemistry Chair one whose incumbent should have " leisure for original work." This was not because they burdened Pedler with teaching but because Government instructed him to carry out the duties of Meteorological Reporter for Bengal concurrently with those of Professor of Chemistry in the Presidency College. The routine tasks of two independent executive posts, performed in separate institutions until his promotion to administrative rank automatically relieved him of both, left Pedler little " leisure."

Though his duties at the Alipur Observatory prevented Pedler from undertaking [original] work at the Presidency College, he [kept h]imself abreast of contemporary pro[gres]s [in] Chemistry and used his knowledge as a means of Science Discipline. Many of his scholars became competent to profit by subsequent chemical training in technical colleges; all came to appreciate the importance of chemical knowledge as such. Pedler did something more : he satisfied literary colleagues that Science is a valuable " ingredient in education." If Pedler's educational work in Bengal hardly fulfilled the expectation of contemporary English chemists, it gained the confidence of contemporary Indian administrators : it brought him promotion as Director of Public Instruction for Bengal; appointment as Vice-Chancellor of the University of Calcutta; nomination to the Indian Legislative Council. The recognition by the Sovereign of these administrative and legislative services suggests that, in this instance, confidence had not been misplaced.

Pedler's work at the Alipur Observatory was of more than technical interest to scientific collegues, familiar with the distinction drawn between natural studies whose inductions from empirical facts may be confirmed or refuted by experiment, and natural studies whose deductions from theoritical causes depend for verification or rejection upon observation. By 1873 it had become unusual to find officers disciplined in a science where " the method of experiment " is essential, equally interested in a science whose results depend on repeated and prolonged observation. Before his selection for service as a chemical investigator, Pedler has assisted a physical Science as dependent as Meterology upon the method of observation; oftener than once, during his Indian career, he gave Astronomy further aid. The success that attended Pedler's meteorological studies only confirmed earlier evidence that he possessed the scientific insight which enabled XVII century " improvers of natural knowledge " to realise that experiment and observation are equally philosophical means to their end.

The late professor Huxley held that, in an ideal University, a man should be able to obtain instruction in all forms of knowledge, and discipline in the use of all the methods by which knowledge is obtained. Though the methods by which knowledge is obtained may vary, experience confirms the truth of the XVII century comment, that, whatever our method, we must ascertain " that things are " and observe " what things do," before we can hope to appreciate " what things are " or understand " how things act."

Since Science and Literature " are not two things," the three forms of knowledge must be common to both: thus they are " two sides of one thing," the word Science no longer connotes all knowledge, but bears the meaning more precisely conveyed by the XVII century term " natural knowledge." *Science Discipline therefore implies* cultural exercise of every method by which natural knowledge can be obtained; as contrasted with Science Training, which implies technical exercise in any method by which natural knowledge may be employed. The distinction between Discipline and Training it at times overlooked by those who consider Education and Instruction convertible terms: even those who admit a distinction between " forming " and "*filling* " the mind, *seem uncertain which* does which. As between cultural Discipline and technical Training, no such confusion should be possible. The sole object of Science Training is to make an adequate number of scholars, already disciplined in the requisite natural knowledge, competent to give the general community effective scientific help. Science Discipline, on the other hand, must serve two distinct purposes. The more special object of Science *Discipline is to furnish those who wish to* give the general community scientific help, with the kind of natural knowledge that will best enable them to profit by the technical training which can alone make them efficient. The more general, but not less important object of Science *Discipline*, should be to render all scholars in any ideal University competent to appreciate the scientific help afforded the general community by those especially trained to *give it.*

Certain " methods by which knowledge is obtained " bave been inherited by particular civilisations from earlier ones. We are indebted to Classical Culture for its partial acceptance of an Oriental Faith, because professors of that Faith preserved and transmitted to Western Europe some acquaintaince with one of these methods. But Huxley has reminded us that Western Europeans interest in " the assemblage of facts," as a means of Instruction and Discipline, was stimulated by local needs rather than inherited from classical tradition, and it may not be amiss to recall *the changes* in In struction and Discipline that have accompanied changes in European modes of thought.

Early University organisation resembled that of contemporary Mysteries, whose apprentices, after Instruction and Discipline by *masters returning to submit the* Masterpiece in whose merit their admission to a Guild depended. Scholars disciplined in the cultural faculty of Arts which then constituted a University, travelled as Clerks to exercise their skill as "wranglers" in other centres of culture, and gain experience of the world by the way. Chaucer has made one XIV century wandering Clerk a friend whom we esteem, because " gladly would he learn and gladly teach." What wandering Clerks learned, ere they returned as Doctors to their own centres of culture, was the existence of popular wants Universities did not meet. The untaught *sought gnidance* in their conduct towards God, Man and Nature: Universities established technical faculties of Theology, Law and Medicine, where Clerks, already " everything about something " of use of the community. The faculty hardest to man was that of Medicine: Universities had to deprive the cultural faculty of Arts of a valuable " ingredient in education," by assigning to the technical faculty of Medicine all teachers versed in the virtues of *animal, mineral* and vegetable products. The new policy met with ecclesiastical approval: the Church, able to supply Universities with teachers of Theology and Canon Law, was eager to secure control of Instruction and Discipline in Ethics and *Philosophy.*

The XV and XVI centuries saw a widening of interest, which the Church encouraged, in Classical Art and Literature: under ecclesiastical patronage new Universities, " complete with all the " faculties," came into existence. The interpretation of hitherto inaccessihle codes of knowledge rendered University Instruction and Discipline critical. The new spirit spread from the cultural to the technical faculties. In Theology, discussion of dogma led to ecclesiastical schism. In Medicine, scholars who tried to find, in familiar objects, those mentioned by ancient authors, now contrasted what authority had said with what they themselves could see, and differed regarding the identity of natural things much as ecclesiastical disputants did regarding points of spiritual doctrine. But any confusion thus introduce into Science *Instruction* was more than compensated for by improvements in Science Discipline; investigators of " the properties of things " substituted the

"method of controlled experiment" for the old expedient of empirical test. The constructive results of those who employed this method offended Faith more than the discussion of dogma offended the Church: Faith, in the XVI century, saw in Physical Science "an irreconcilable enemy, to be excluded at all "hazards." Teachers of Philosophy, warned in time, escaped ecclesiastical displeasure by restricting Discipline in Reasoning to the discussion of topics that could not offend Faith.

A political change in 1660 enabled this College to become, by 1663, a Society to "Improve Natural Knowledge" by means of experiment and observation — the methods employed by Harvey in 1617; for use or discovery—the purposes, reversed in order, that Bacon had urged.

This extra-academic decision had an effect on Science Discipline. To an early University, cultural in purpose, the Arts were also the Sciences. After the establishment of technical faculties, teachers of Philosophy came to consider any subject taught in the faculty of Arts a "Science," and any subject taught in the faculty of Medicine an "Art." The decision of 1663 rendered teachers interested in the nature of things willing to apply knowledge; those interested in the qualities of things anxious to advance knowledge and convert their particular Arts into Sciences. But changes in modes of thought do not always proceed evenly. In 1669, one English University replaced Instruction in Phytology, the Art of knowing and finding out the Temperature, Vertues, and Use of Plants, as serving to the Curation and Sustenation of the Body, by Discipline in Botany, the Science of Knowing and Naming Plants. While, as a consequence of this advance in Science Discipline, a theological scholar of the sister English University was perfecting a synoptic method of classification to assist that Natural Science in arranging its assembled facts, a fellow of the Royal Society, accustomed to contract the Sciences with the Arts, thought a Physical Science that lent itself to application, hardly more difficult than an Art. There were other indications than University Discipline in reasoning had not increased in rigidity since it discarded Scholastic Controversy.

Academic ability to apply natural knowledge did not keep pace with success in finding new facts: conditions that favour discovery do not always provide the knowledge of practical needs that assists appreciation [illegible]

ledge for use provoked the appearance, in 1726, of an account of an Academy of Projectors" by an Irish Dean who sympathised with the application of natural knowledge, but was aware that the common people were constant irreconcilable enemies to Science. Popular antipathy caused teachers of Natural Philosophy to confine attention to the advancement of natural knowledge, and leave its application to the initiative of the Arts and Crafts. The old distinction between an Art and a Science appeared in a new form: contrasting what they were inclined to with what they had no mind to, physical scholars thought that pure Science differed from applied Science.

Association with a technical faculty enabled teachers of Natural History to avoid this error for a generation. But while men of letters in England were smiling at Swift's account of the Academy at Lagado, a young Swedish naturalist was excogitating an artificial system of Classification, based on modifications met with in the characters of the organs connected with a particular vital function. When System was perfected in 1753, it proved so superior to Synopsis as a guide to Identification, that one Scottish University made Instruction and Discipline in Natural History an essential ingredient in education of its Arts curriculum. The interest of teachers who used the rival methods became so restricted to the characters of natural things, that, in 1768, when system was adopted in England, another Scottish University appointed a teacher of Materia Medica to give medical scholars technical instruction in the qualities and uses of animal, mineral and vegetable products. Teachers of Natural History, who now thought they were imparting Instruction in pure science, were not allowed to entertain that idea long: men of affairs, interested in natural knowledge, assured them that what they taught was not Science at all. Soon after the new method was adopted in this country, a legal Fellow of the Royal Society pointed out that if System aided Identification more than Synopsis had done, its effect of description was unfortunate: continental faunists, who now diagnosed animals by particular marks, allowed their descriptions to run in general terms. The choice of a President of the Royal Society in 1778, provoked a complaint, by the same critic, that a Science to which the new President was devoted, had become a pursuit that amuses the fancy and exercises the memory without improving the mind or ad-

This Academic admission that Natural Knowledge may be an ingredient in education, attracted to problems in Biology some of the attention given by Philosophy to problems in Physics. Direct intervention by Philosophy proved ineffective, less because of its Idealism, than because its attention was confined to complex organisms. Indirectly, Philosophy taught Natural History to appreciate Morphology as a study apart, and to realise that, though the study may be static, its modes are momentary; also, that the identification of organisms by particular marks should be but the prelude to study of the natural affinities that indicate the plan of creation. Attempts to find Natural System led Histology to look for structural evidence of relationships unrevealed by form or function, and stimulated a study of geographical distribution that removed mediaeval misapprehensions, resolved Renaissance doubts, and extended economic and systematic knowledge.

The effect on Chemistry was equally marked. The four classical elements had been found to be respectively, a complex, a compound, a mixture, a reaction. Chemists who established the actual Elements discarded deductions from theoretical causes in favour of experimental proof of inductions from established facts. Appreciating the value of System, they advanced knowledge by supplying deficient members to familiar series of compounds. As teachers, they contributed to Science Discipline a new method by which natural knowledge is obtained: noting the advantage of dissection to scholars of Anatomy, and of field-study to scholars of Natural History, they devised laboratory exercises, and invented the tutorial practical instruction adopted later by teachers of Morphology and Physiology.

The overthrow, early in the XIX century, of an empire similar to that of the VIII century, induced conditions which caused a literary critic to assure scientific contemporaries that they were a general of talkers who had been left nothing to discover. If little occurred to belie this comment while Hazlitt lived, amends were made after his death: the following year saw the birth of the British Association for the Advancement of Science. This was but a local reaction to the general movement which led Morphology to investigate the inner structure of animals and plants as mechanisms; Chemistry to estimate the influence of inorganic food on organic growth; and Philosophy to remark that to see things become, is the best way to explain them. The study of inner structure brought appreciation of the practical consideration that this should begin with simple organisms. The study of the cellular structure of simple organisms led, a decade later, to study of the cells composing the tissues of organisms more complex. The significance of the growing point in plants, neglected since its discovery in 1759, was now realised, and brought with it appreciation of the advice to see things become: Morphology, till then the static study of Form, became transformed into the dynamic study of Development.

Anatomy and Physiology, already in dispute over the right to teach medical scholars minute anatomy, vied in their efforts to annex the new study. But Morphology, ambitious to remain a pure science, with arguments "like quills upon the fretful porcupine," reminded Anatomy that the whole is greater than its part, and explained to Physiology that its proper duty is to apply the principles of Physics and Chemistry in ascertaining the modes and conditions of the action of the body, as a mechanism. Satisfied that Development provided the key to the plan of creation, morphologists told philosophers that their comments on biological problems were idle chatter; advised chemists who studied nutrition, to return to the Lower School; and informed natural historians, interested in geographical distribution and systematic classification, that they were gleaners of hay.

Some of these estimates Morphology revised when Natural History, sixteen years later, gave Philosophy and Science a Doctrine of Descent that induced a return by Faith to the attitude adopted by the Church towards Physical Science in the XVI century. If this doctrine, which Faith at first treated as an irreconcilable enemy, found a defender in Morphology, Natural History repaid the debt by accepting morphological leadership. That leadership, on the animal side, Morphology retains. But on the plant side, teachers resolved, while the controversy as to Evolution raged, to adopt the advice neglected since 1778, and graft the gardener, the planter, and the husbandman on the phytologist; they made tutorial practical instruction in the static study initiated by Hales in 1726, the basis of dynamic Discipline in Vegetable Physiology on the nutritive side. Room was found, in the medical course, for the new study by giving up Instruction in System, and limiting static morphological interest in Distribution

and Structure mainly to evidence supplied by Geology. The dominance in Botany of the study of Fuuction over that of Structure was assured when Physiology adopted, as Ecology, the old interest of Natural History in plant-association. This, combined with the economic interest of Physiology proper in production, accounts for the fact that Academic Botany was a branch of natural knowledge which realised, before Huxley had to remind other studies of the fact, that what people call applied science, is nothing but the application of pure science to particular problems.

Such were the conditions as regards Science Discipline in this country when, a few months after Pedler reached India, Huxley brought against the activity a charge which differed in substance from that made by Barrington a century earlier. As a result of their progress during the preceding generation, Medicine and Science threatened, Huxley said, not only to crush one another, but to press the very life out of the unhappy student. This charge differed from the earlier charge in another respect: it was unanswerable. The humanity of this statement, made in 1874 to an audience of undergraduates in a Scottish University, was appreciated by his hearers; we knew it was sincere because our Lord Rector added that he should not hesitate to exclude from the medical course, the branch of natural knowledge to which his own life had been specially devoted.

The faculties of Science advocated by Huxley as essential for the preparation of scholars for technical training, are sometimes asked, not only to prepare scholars for training, but to train them as well. We know from the experience of University schools of Medicine, of Agriculture, of Engineering, and especially from that of independent Colleges of Science and Technology, that both preparation and training can be supplied in one faculty: we know, too, that the Science Discipline which preparation implies, does not lose its cultural value when given in a technical faculty—Huxley has reminded us that the Discipline in Physiology which a prospective scholar of Medicine must undergo, may in itself provide a better Education than much of what is accepted under that name. But, while the purpose of specialised Science Discipline is cultural, its method has to conform with the technical principle of teaching everything about something; the Art by which the scholar will eventually be trained is perhaps as competent to decide what this specialised Science Discipline should include, as the Science which prepares the scholar for that training is likely to be. What we find, when a faculty of Science does undertake both training and preparation, is that its scholars may have been converted into expert entomologists or expert mycologists without having come to realise, what every scholar of medicine knows, that Physiology and Pathology are two sides of the same shield.

This occasional academic inability to distinguish between the functions of a technical and a cultural faculty is, however, of less consequence than the failure of teachers of Science to make their Universities understand the difference in method between the extensive Science Discipline which ensures general culture, and the intensive Science Discipline which prepares for technical training. Teachers of Literature, with the same problem before them, experience little difficulty in persuading their Universities to do what is required. Some Universities expect their faculties of Science, organised to impart culture to scholars who ought to have that culture before being permitted to enter a faculty of Science. It is not altogether impossible to give general Science culture and specialised Science Discipline in the same faculty; the teacher whose labours this lecture commemorates, like many others before and since, did so in Chemistry, though even in Chemistry it is easier to modify the teaching appropriate to a faculty of Arts so as to suit the purpose of a faculty of Science than the reverse. In a biological subject the method of tutorial practical instruction may, in a faculty of Science, be used by a careful teacher to illustrate general features and broad principles by means of selected types, but the exigencies of academic tests and the finding of Boards of Study as a rule compel teaching in that faculty to take the form of Instruction that includes everything about something, rather than of Discipline that leads the scholar to know something about everything. The attempt to impart general scientific culture in a faculty of Science, instead of doing this in a faculty of Arts, has the disadvantage of leading scholars to overlook another lesson. Natural Knowledge, Huxley once said, in tryiug to meet popular needs, has found the ideas than can alone still spiritual cravings; in endeavouring to ascertain laws of

comfort, has been driven to discover those of conduct. Science and Literature are not two things : cultural Discipline in the faculty of Arts tries to satisfy spiritual cravings and teach laws of conduct. But two sides of one thing may treat a common purpose differently : a duty regarded by the faculty of Arts as fundamental, seems to teachers responsible for Discipline in what Universities term pure Science, to be the casual concern of teachers responsible for the technical training of scholars in what people call applied Science : teachers of Medicine may well claim that their faculty is a cultural one.

The teachers in the faculty organised to give Instruction in Science because of its bearing on the wants of Mankind, who accept the academic distinction drawn between pure and applied Science, show that, whatever be their attitude towards Ethics, they disregard Philosophy : acceptance of that distinction involves adoption of the idea that an advance in natural knowledge, however slight, is of greater consequence than any application of natural knowledge, however important. Teachers of Science in the XX century have therefore to guard against using Discovery as teachers of Natural History in the XVIII century used System, and teachers of Philosophy in the XVI century used Controversy; as an end in itself, instead of as a means to an end. This particular danger, and some of the risks we run of being submerged by the rising tide of scientific literature, we may hope to escape when our Universities adopt Professor Huxley's advice, and general Science Discipline, by teachers using methods appropriate to the faculty of Arts, is regarded as an essential precursor of the intensive Science Discipline required in a faculty of Science : scholars who now find it necessary to publish the results of an academic investigation in a pamphlet of sixteen pages, may be able, like their predecessors of a century ago, to embody their conclusions in a footnote.

We need not despair. It is not much more than half a century since Huxley pointed out that there are two types of Science Discipline and that these must be provided in two different ways. His advice as regards one of the type has already been taken. Perhaps, in due course, the difficulties that call for the existence of associations like the British Science Guild may come to be appreciated by those responsible for the organisation of Science Discipline, and Huxley's advice as regards the other type may be taken.

ELECTRODEPOSITION OF CHROMIUM-IRON ALLOY.

By G. Fuseya and K. Sasaki.

Experiments were performed to find the best conditions of electroplating with so-called stainless iron, *i.e.*, iron containing more than 16 per cent. of chromium. A chromic acid bath for chromium plating, with iron salts added, did not give any good deposit of the alloy, and therefore a mixed solution of ferrous sulphate and chromic sulphate was used.

No report can be found in the literature on the electrodeposition of this alloy.

Theoretical.

Several reports are found in the literature on the electrodeposition of chromium from its salt solutions. The essentials of the conditions of electrolysis given in these papers are tabulated in Table 1. The table shows that very high current densities, such as 10-60 A/dm^2, are necessary for the deposition of iron, as may be seen from Hughes' résumé (*Trans. Amer. Electrochem. Soc.*, 1921, XL, 185), far smaller current densities, such as 0.2-3 A/dm^2, are generally suitable. Therefore, the co-deposition of the two metals seems to be very difficult.

The equilibrium potentials of iron and chromium also lead to the same conclusion. Because, according to the normal potentials of $Cr|Cr^{++}$ and $Cr^{++}|Cr^{+++}$ the most part of the chromium ions must be in the chromous state in the vicinity of the cathode and the normal potential of $Cr|Cr^{++}$ (= -0.56 v according to Grube and Breitinger, *Z. Elektrochem*, 1927, XXXIII, 112) being far less than that of $Fe|Fe^{++}$ (= -0.44 v according to Hampton, *J. Phys. Chem.*, 1926, XXX, 980), chromium in a solution one mol of Cr^{++} has the same potential as iron in a solution 10^{-4} mol of Fe^{++}.

On the other hand, however, the polarisation in the electrodeposition of iron seems, according to the experimental results described below, to be greater than that in the electrodeposition of chromium and this fact acts favourably to the co-deposition of the two metals. Besides, iron has a depolarising action, though it is very slight, to the deposition of chromium, since the two metals form solid solutions in all proportions.

TABLE I.
CONDITIONS FOR ELECTRODEPOSITION OF CHROMIUM FROM SALT SOLUTIONS.

	Electrolyte	Anode	Dk in A/dm²	Curr. eff. in %
Bunsen	$CrCl_3$	Carbon	67	—
Moeller and Street	Cr alum	—	40	30
S. Cowper-Coles	$CrCl_3$	—	4.3—4.5	—
J. Férée	$CrCl_3$	—	15	45
B. Neumann and Glaser	$CrCl_3$ and $Cr_2(SO_4)_3$	Pb, Pt, C	9.1	38.4
H. R. Carveth and W. R. Mott ...	$CrCl_3$	Pb	10—40	28
H. R. Carveth and W. R. Mott ...	$Cr_2(SO_4)_3$	Pb	30	30
M. Le Blanc	$Cr_2(SO_4)_3$	Brass, C	20	40
W. Traube, E. Burmeister and R. Stahn	$CrCl_3$	Pb	56	—

PRELIMINARY EXPERIMENTS.

(1) A solution of chromium sulphate only was electrolysed at first. A violet form of chromium sulphate, prepared from chrome-alum by Higley's method (*J. Amer. Chem. Soc.*, 1904, xxvi, 626) was used, but it changed partly to a green form in the solution. A copper plate was used as a cathode and an iron plate as an anode.

It was found that acidity a little less than that produced in the formation of the green form of chromium sulphate is to the most suitable for the deposition of bright metallic chromium, while a higher acidity caused hydrogen evolution only and a too low acidity induced the inclusion of much hydroxide in the cathode deposit. It was found by experiments that 0.05—0.1 mol free sulphuric acid per litre is the most suitable and therefore a little sodium hydroxide was added to the solution till it attained this acidity. To keep this suitable acidity, boric acid, oxalic acid or tartaric acid may be used.

The determination of the content of free sulphuric acid was made after precipitating out all salts and hydroxide present, by the addition of acetone, filtering and distilling off the acetone from the filtrate. Preliminary experiments were made to test the applicability of this method. The acidity of dilute solutions of chromic sulphate determined by this method was compared with the values calculated from pH determined by an indicator method. Thymol blue was used as the indicator. Solutions more concentrated than 0.05 mol/*l* could not be used owing to its own deep colouration. Table 2 shows the results of these preliminary experiments.

TABLE II.
COMPARISON OF TWO METHODS OF DETERMINING FREE ACID CONTENT.

	$Cr_2(SO_4)_3$ only			With 0.0005 mol H_2SO_4/l	
$Cr_2(SO_4)_3$ used in mol/*l*	0.01	0.02	0.05	0.01	0.02
Free acid in mol/*l*—					
by indicator method	0.00042	0.0005	0.0122	0.0006	0.00075
by acetone method	0.00043	0.0006	0.0135	0.0005	0.00067

(2) A solution of chrome-alum did not give a good bright deposit. But when the violet form of chromium sulphate in it was changed to the green form by heating the solution, the same bright deposits as in the case of the chromium sulphate solution were obtained. It seems that chromium ions have a greater tendency than complex ions to form hydroxide at the cathode where many hydrogen ions are discharged. However, chrome-alum is not suitable for the [illegible] the green form of being reconverted into th[e] violet form in the presence of the alkal[i] metal sulphate.

(3) Commercial chromium sulphate of [the] green form contains much insoluble colloid[al] matter and gives dirty deposits only.

MAIN EXPERIMENTS OF ELECTRODEPOSITIO[N]

Experiments were carried out using mixe[d] solutions of 1—2 mol of chromium, 0.15—0.5 mol of iron and 0.05—0.1 mol of fr[ee] sulphuric acid, to find the effects of vario[us] conditions of electrolysis on the compo[sition]

tions of the alloy, current efficiencies and the appearance of the deposits. Copper plates were used as cathodes. Artificial magnetite rods were used as insoluble anodes, in order to keep the acidity nearly constant by regenerating hydrogen ions which are discharged abundantly along with the alloy at the cathode. For the same purpose, several other kinds of insoluble anodes were tried such as lead, graphite, carbon, and platinum, but they were found to be unsuitable because they oxidise chromic sulphate to chromic acid while magnetite does not. Since the current efficiency of the deposition of the alloy is very small, the acidity did not change so much in the course of a few experiments, even though magnetite only was used as an anode. In practical application two anodes must be used, one being iron and the other magnetite, and chromium hydroxide must be added from time to time with the depletion of chromium ions in the solution.

The deposits were analysed in the following way. After dissolving them in sulphuric acid, a part of the solution was titrated for iron with potassium permanganate. Chromic sulphate in the remaining part of the solution was converted into chromic acid by Barba's method (Treadwell-Hall, *Analyt. Chem.*, 5 Ed., 1919, Vol. II, p. 854) or with ammonium persulphate (Cf. G. L. Kelley & J. B. Conant, *J. Ind. Eng. Chem.*, 1916, VIII, 719), and then to the solntion was added ferrous sulphate and it was titrated with potassium bichromate using diphenylamine as an indicator (Cf. J. Knop, *J. Amer. Chem. Soc.*, 1924, XLVI, 263).

The experimental results obtained are as follows :

(1) Effect of duration of electrolysis. The deposits obtained within about 20 minutes are in the same current efficiency, which fact means that the amount of deposits are proportional to the time of electrolysis. After about 20 minutes the current efficiencies decrease because at this time the whole surface of copper is completely covered with the alloy, the overvoltage of whieh is very low, and hydrogen evolution occurs more vigorously than before. Chromium content in the deposit also becomes less when the electrolysis is continued more than 20 minutes.

(2) Effect of current density. The larger the current density, the larger both the content of the chromium in the deposit and the current efficiency. These results can be explained in the following way.

Suppose that the polarisation in the electrodeposition of iron or chromium is greater than that in hydrogen evolution as hydrogen overvoltage on these metals is comparatively small, and also that the polarisation in iron deposition is greater than that in chromium deposition. Then the current density-potential curves for iron, chromium and hydrogen can be represented by Fe, Cr and H respectively. The S-curve is drawn by adding the current densities in H-, Fe- and Cr-curves at each potential. This curve cannot be considered directly to show the relation between the current densities and the potentials in the co-deposition of hydrogen, iron and chromium from the mixed solution, because depolarisation takes place in the deposition of the two metals which form solid solutions in all proportions. However, since the depolarisation in this case, differing from that in the case of forming compounds, is small, it can be neglected in inferring the tendency of the effects of various conditions of electrolysis on the current efficiencies and the compositions of the deposits.

(3) Effect of acidity. The larger the acidity, the smaller both the content of chromium in the deposit and the current efficiency.

(5) Temperature has similar effects to those of the acidity, because the hydrogen overvoltage becomes smaller as the tempera ture rises.

(5) Effect of the concentration of ferrous *sulphate*. A *larger concentration* of ferrous sulphate increases, as a matter of course, the current efficiency and lowers the content of chromium in the deposit.

PROPERTIES OF DEPOSIT.

(1) Content of oxide oxygen and appearance. It was found in the analyses of the deposits that the sum of the weight of the iron and the chromium is always a few per cent. less than that of the deposit. This deficit must be attributed to the oxygen present as a chromium oxide, but not to the hydrogen since the weight of hydrogen contained in electrolytic iron or chromium is very small.

Table 3 shows the change of the content of this oxygen under various conditions of electrolysis. It becomes the larger, the larger the current density and the lower the acidity. The elevation of the temperature induces the greater hydrolysis and therefore has the same effect on the content of oxygen as the acidity has.

TABLE III.

CONTENT OF OXYGEN IN DEPOSITS.

(Electrolyte : 1.043 mol Cr/*l*, 0.537 mol Fe/*l*).

Temp.	H_2SO_4	Current Density in A/dm²						
		7.5	8.75	10	12.5	15	22.5	28.75
22	0.096	—	0	—	2.5	4.78	7.65	—
15	0.079	—	0.57	—	3.28	—	5.51	—
13	0.099	0	—	4.3	5.7	—	7.79	9.62
9	0.079	3.2	—	—	5.8	7.15	7.9	—
4	0.117	—	2.49	—	—	4.41	0	—

The deposits appear cloudy or dark when the content of oxygen is more than 5 per cent., and therefore the acidity and the current density must be kept within a certain limit to suppress the amount of oxygen entering the deposit. The best conditions for obtaining bright deposits of metallic lustre are as follows :— the solution containing gl—2.5 mol Cr/l, 0.5 mol Fe/l and 0.05—0.1 mol free H_2SO_4/l; the temperature about 15° C.; and the current density 8—15 A/dm². Then the composition of the deposits is 60—70 per cent. Fe; 30—45 per cent. Cr; and 1—5 per cent O. The current efficiency becomes somewhat greater when both magnetite and iron anodes are used combined than when magnetite anodes only are used.

TABLE IV.

ELECTROLYSIS WITH MAGNETITE AND IRON ANODES.

Dk in A/dm²	5	6.25	7.5	8.75	10	11.25	12.5
Curr.. eff in %	5.74	10.05	13.52	18.44	22.09	23.79	23.02
Cr content in %	13.22	21.22	28.07	32.72	35.59	37.02	37.02
Appearance	good	good	good	fairly good	fairly good	dark	dark

(2) Structure of deposit. Experiments were performed to determine whether the alloy produced by electrodeposition is simply a mixture of the crystals of each element or a solid solution.

It is known that electrolytic iron has the body-centred cubic form, the lattice constant of which was found to be 2.861 A. On the other hand, contradictory statements were published on the structure of electrolytic chromium. E. A. Ollard (*Metal Ind.* (London), 1926, XXVIII, 153), A. J. Bradley and E. A. Ollard (*Nature*, 1926, CXVII, 122), and D. J. Macnaughton (*Metal Ind.* (London) 1926, XXVIII, 175), reported that two forms, *i.e.*, the body-centred cubic and the hexagonal close-packed, are present in the electrolytic chromium from chromic acid, while C. S. Smith (*Metal Ind.* (London), 1926, XXVIII, 456) found the body-centred cubic form only in the electrolytic chromium either from a chromium sulphate solution or a chromic acid solution and F. Sillers (*Trans. Amer. Electrochem. Soc.*, 1927, LII, 301) obtained the same result as Smith did by electrolysing a chromic acid solution.

It was found by X-ray spectrograms that the electrolytic chromium produced at room temperature from a chromium sulphate solution has a body-centred cubic form when the current density is below 15 A/dm² while it has a hexagonal close-packed form when the current density is above 18 A/dm². In the interval of these two limits of current densities, a mixture of crystals of both forms is produced. The lattice constant of the body-centred cubic form was found to be 2.877 A. The details of these experiments will be published in another paper by one of the writers (Sasaki) and Sekito.

In the experiments of the deposition of the alloy, the electrolysis was performed at the current densities below 15 A/dm² and at room temperature, the condition under which chromium takes the cubic form.

Since the lines of the spectrogram of the alloy diffused and accordingly the lattice constant could not be calculated, a comparison method was used. The spectrograms of the alloy and iron were taken simultaneously side by side on one film and those of the alloy and chromium on another

a solid solution of the body-centred cubic form, and the lattice constant of which lies between those of iron and chromium. Therefore the alloy produced by electro-deposition has the nearly same structure as those obtained by a fusion method (Cf. Westgren, Phragmen and Negresco, *J. Iron and Steel Inst.*, 1928, CXVII, 383.)

(3) Corrosion test. The deposit resisted the action of saturated solutions of NaCl, NH_4Cl, oxalic acid, tartaric acid, a concentrated solution of acetic acid and a 6N solution of NH_3, when the base metal was covered completely and the chromium content in the deposit was comparatively high.

DEFICITS OF THE PLATING BATH.

The current efficiency is very small, and it is very difficult to cover uniformly the whole surface of an object as the solution has very small throwing power.

The writers wish to express their thanks to Mr. S. Sekito for his help and counsel in determining the structure of the deposit by means of X-ray spectrograms.

OPENING IN SCIENTIFIC INDUSTRY.

On November 26, Professor H. T. Tizard, Rector of the Imperial College of Science, South Kensington, lecturing at King's College, London, on "*Scientific Industry* as a Career," said that there was a growing demand for the physicist in industry, and industry had not really been educated up to the need of the physicist, although it had to the need of the chemist. The demand exceeded the supply, and was likely to go on increasing.

There was a complaint, he added, that the number of men from British universities who were trained to be capable mining engineers were too few. This was due to the uncertainty of employment, and the result was that big mining areas in the Dominions and Colonies were very largely staffed by Americans, no British candidates being available. This gave rise to some anxiety. It would be very unfortunate to see the big mining deposits of the British Empire to a great part scientifically controlled by foreign nations.

The mining companies of London, anxious to encourage candidates, offered seven scholarships of £100 a year at the Royal School of Mines last summer for boys from selected public schools. "I was prepared for getting very few candidates, but I was not prepared for the actual result. There were no candidates—not one boy in all these selected public schools who was

THREE HUNDREDTH ANNIVERSARY OF CINCHONA'S USE.

The application of the alkaloidal constituents of Cinchona bark to medicine dates back many centuries. Its known use by Europeans, even, goes back to 1630 at least and this is now being recognised by the very interesting Exhibition and Tercentenary Celebrations this month at the Wellcome Historical Medical Museum, 54 Wigmore Street, W.1.

The exhibition was opened by His Eminence Cardinal Bourne, addresses being delivered by H. E. Marquis de Merry de Val, Ambassador for Spain, H.E. Marquis de Fleuriau, Ambassador for France, and H.E. Senor Don A. Gonzalez-Pnoda, Minister Plenipotentiary of Peru. Many distinguished visitors attended the reception. Dr. H. S. Wellcome was the Chairman on December 10th, when Sir David Prain, F.R.S., Dr. Ramsbotham, and Professor Salisbury delivered addresses.

The event was also marked by the issue of an elaborate and excellent illustrated catalogne—monograph of the exhibition.

The Cinchona Tercentenary Celebration has been organised to mark the first recog- this remarkable remedial agent, the addi- nised use of Cinchona Bark by Europeans.

An extensive collection of Exhibits has been arranged to illustrate the history of, tion of which to the world's medica has, for three hundred years, proved itself to be of incalculable value, especially in tropical regions. The lives of untold millions have been saved by the nse of Cinchona Bark and its active principles.

From the time when the therapeutic properties of Cinchona Bark became known to the Old World, until, and since, the scientific researches resulted in the discovery of quinine and other derivative constituents by *Pelletier and Caventou and others, there* have occurred many interesting phases in the history of Cinchona.

The distinguished botanical name of the *genus Cinchona was invented* by Linnaeus. This title was suggested by the titular name "Chinchon" of the Countess Francisa Henriquez de Ribera, the Vice-reine, and second wife of the Viceroy of Peru. The Vice-reine was cured of fever at Lima by the administration of Cinchona Bark prescribed by the Court Physician, Dr. Juan de Vega.

Linked up with the history of Cinchona Bark are the pioneer exploring expeditions of the venturesome Spaniards in South America, its introduction to all parts of the world, especially by Jesuit Missionaries, and also later research expeditions of

GENERAL NOTES

BRITISH INDUSTRIES FAIR.

That a site easily accessible from Central London should be acquired for permanent buildings for the British Industries Fair and that the Government should establish a regular annual publicity grant of a minimum of £100,000 (instead of £25,000 granted for a year at a time as at present) are among the recommendations of the Committee, under the Chairmanship of Lord Chelmsford, whose Report on the future of the Fair has just been published.

"The Fair should be developed, so as to become a truly national manifestation of the quality and range of British products and an increasingly powerful factor in the expansion of our trade. The Government and manufacturers generally should accord it more vigorous support, and the public should be encouraged to learn through the Fair that British manufacturers can supply their needs."

It is urged that His Majesty's Government, recognising the Fair "as an integral feature of our economic policy, should back up more vigorously, on a scale not incommensurate with the support accorded to the Empire Marketing Board, the enthusiastic individual efforts which have brought the Fair to its present strength. 'Sell British Goods' is not less important than 'Buy British Goods.'"

OUR OVERSEAS TRADE IN NOVEMBER.

Preliminary figures of United Kingdom trade for November show imports valued at £97.4 million and exports valued at £44.1 million, as compared with £108.2 million and £63.1 million respectively in November, 1929.

PROSPECTING IN CANADA.

Although metal market conditions have had their influence in arresting the pace of mining development in Canada, prospecting for new mineral deposits is still in progress particular interest being taken in the search for new gold deposits or in a further examination of producing areas.

In this connection, attention is directed to the publication by the Geological Survey at Ottawa of Volume No. 7 in its new Economic Geology Series devoted to "Prospecting in Canada," this work being a co-operative effort by a number of members of the Survey Staff.

Attempt has been made in this work to incorporate the experience and knowledge of a body of geologists in the Survey who have had opportunity to specialise in the various branches of geology and to gain personal knowledge, collectively of more parts of Canada than have been traversed by members of any other organisation. Although such extensive collaboration has had advantages, it has also attended by some difficulty in obtaining a balanced result. To some extent the book is a series of essays on economic geology instead of the more orderly arrangement to be found in standard textbooks, but throughout an endeavour has been maintained to present in as simple language as possible information especially applicable in Canada that will assist in the self-education of that important figure in the Canadian mining picture—the prospector.

The volume is one of six chapters amply illustrated by photographic plates and figures. Chapter I, by Dr. G. A. Young, discusses the elements of geology and mineralogy, this being followed by one contributed by Drs. H. C. Cooke, W. A. Johnston and W. E. Cockfield, describing the Formation and Destruction of Mineral Deposits.

Types of Mineral Deposits are dealt with in Chapter III, deposits of igneous or sedimentary origin being classified in Papers by various members of the Survey Staff specialising in the varieties of minerals included in these two broad classifications.

In Chapter IV, Dr. F. J. Alcock gives an outline of the geology of Canada, and in Chapter V a number of members of the Survey Staff describe the physical phenomena of ore deposits and give data as to magnetic and electrical methods of prospecting.

In the final Chapter there are a number of Papers dealing with field practice, including information relative to prospecting equipment, practical surveying instruments, development of properties, geological maps and reports, and mining laws. The work concludes with a useful index.

Copies of the volume can be obtained by persons interested from Canadian Building, Trafalgar Square, S.W.1.

WHOLESALE PRICES IN NOVEMBER.

A further slight decline of 0.9 per cent. is noted in the course of wholesale prices during last month, the index number for which is returned at 67.4, as against 68.0 for the previous month, and 80.6 for November, 1929.

We have received the first number of an interesting Guatamalan University publication, *Studium*, which is to appear quarterly and will deal mainly with chemical and scientific matters. It gives an account of the visit of some Guatamalan students to San Salvador, the German chemical industry, biological, literary and cultural articles book reviews and summaries.

FOREIGN MATERIALS USED ON BRITISH ROADS.

INCREASE IN ASPHALT AND BITUMEN IMPORTS

In spite of the Minister of Transport's plea for the more general use of British tar for British roads, there is a substantial increase in the quantity of highway materials imported from abroad. According to the returns for last year, published on (Monday, December 8), 199,476 tons of bitumen and asphalt, valued at £981,946, came to this country from abroad, as compared with 187,453 tons, valued at £886,868, in 1928.

DE-ACETYLATION OF ACETYL SUGARS.

In a paper published in the current issue of the U.S. Bureau of Standards *Journal of Research* describing work on the ring structure of mannose, S. S. Isbell describes a new and very satisfactory way of de-acetylating acetyl derivative of mannose and other sugars.

When acetylated sugars are heated with sodium methylate de-acetylation is accompanied by considerable rearrangements since the solution becomes very alkaline.

By using barium methylate, smaller quantities were found adequate and there were no complications accompanying the removal of the acetyl groups.

Moreover, any barium present after the reaction can readily be removed whereas sodium compounds are not so easily removed from these reaction products.

3,000 CANDLE POWER GAS LAMPS.

CHEAPER AND BRIGHTER THAN ELECTRICITY.

After considering schemes submitted by both gas and electricity engineers, the Coventry General Works Committee have decided to install high-pressure gas lamps in Corporation Street, one of the principal thoroughfares of the city.

The new standards will each carry two lamps of 3,000 candle power. The cost of the installation will be £416, as compared with an estimate of £495 for electric lighting of a lower candle power.

Before making their decision the Committee visited London and inspected the latest lighting installations in important thoroughfares. They saw the new lamps on the Embankment, which are described as the most up-to-date electric lights in the world, and also the experimental test miles of high-pressure gas lamps and electric lamps along the Lewisham Road. The Committee were impressed by the high-pressure system installed by the South Metropolitan Gas Company at Lewisham, and the even diffusion of light by those lamps largely influenced them in their decision.

COAL OUTPUT IN THE UNITED KINGDOM.

About 56½ million tons of saleable coal were raised, as compared with 58 million tons in the previous quarter and about 62¾ million tons in the corresponding quarter of 1929.

As compared with the previous quarter, the principal reductions were in Scotland (10 per cent.), Lancashire, Cheshire and North Wales (8 per cent.), Durham (8 per cent.), while the only substantial increase in Derbyshire, Nottingham and Leicester (8 per cent.).

As compared with the corresponding quarter of 1929 there were reductions of output in all districts, the heaviest being in Northumberland (21 per cent.), Durham 18 per cent.), Scotland (12 per cent.), South Wales and Monmouth (10 per cent.), and Yorkshire (9 per cent.).

Proceedings and Notices of Societies

THE ROYAL INSTITUTION.

Juvenile Lectures.

"The Electric Spark." By Prof. A. M. Tyndall, D.Sc., M.R.I.

Tuesday, December 30, 1930, at 3 p.m.—I.—"Some Properties of Electrified Bodies."

There are two kinds of electricity, known as positive and negative. Two bodies oppositely electrified attract one another as though they were connected by stretched elastic threads. The two electricities are present in equal quantities in all so-called unelectrified bodies, but they can be separated by various means. A charge of electricity can be transferred from one place to another by suitable carriers or by movement along "conductors" such as the metals. The electricity on a charged conductor seems to lie entirely on the surface. The air between two oppositely electrified bodies is under a strain. This strain is measured in volts. If the amount of electricity upon these bodies is increased, the strain increases. When the strain becomes too great, a quantity of electricity sufficient to relieve the strain rushes across from one body to the other. This is the phenomenon of an electric spark.

Thursday, January 1, 1931, at 3 p.m.—II. "The Spark as a Current of Electricity."

The voltages necessary to produce a spark between two bodies depends upon their form and upon the nature and thickness of the material through which the spark must pass. If the voltage is high enough, a solid layer such as a glass plate may be pierced. An electric spark is a flow of electricity constituting a momentary electric current. This may be illustrated by the fact that, like a continuous current from a battery, this momentary current generates heat, can produce magnetic effects, and can decompose water. The high voltages necessary for electric sparks may be obtained from "static" machines. They may also be obtained from transformers, induction coils, and magnetos, which are applications of a most important discovery made by Faraday a century ago.

Saturday, January 3, 1931, at 3 p.m.—III. "Air as a Conductor of Electricity."

Since air is normally a non-conductor, carriers of electricity called "ions" must be created in the air if the spark is to pass. Ions play a very important part in the mechanism of the world, and are most interesting objects which we shall consider carefully. Their movement in conducting air may be studied. The electric current that they give rise to depends upon their number and the speed with which they move. The electric charge that each carries may be found. Striking changes take place in the appearance of sparks or streams of ions through vessels in which a vacuum is gradually being produced. Parts of the discharge may be no longer luminous, and new phenomena such as fluorescence also make their appearance.

THE PHYSICAL AND OPTICAL SOCIETIES.

Twenty-First Annual Exhibition.

The Twenty-First Annual Exhibition of the Physical and Optical Societies is to be held on Tuesday, Wednesday and Thursday, January 6, 7 and 8, 1931, at the Imperial Institute Road, South Kensington, and will be open in the afternoon from 3 p.m. to 6 p.m., and in the evening from 7 p.m. to 10 p.m. This being the Twenty-First Exhibition, Professor Sir Arthur Eddington, F.R.S., has kindly consented to mark the occasion by performing an opening ceremony on Tuesday, January 6, at 2.30 p.m.

Over eighty firms have accepted the invitation to exhibit in the Trade Section at this Exhibition. A group of Research and Experimental exhibits is also being arranged, and some interesting historical exhibits will be included.

Two Discourses, with experiments, will be given at 8 p.m. on the second and third days as follows :—

January 7—Mr. E. Lancaster-Jones, B.A.—"*Searching for Minerals with Scientific Instruments.*"

January 8 — Professor Sir Gilbert Walker, F.R.S.—"*Physics of Sport.*"

A section of the Exhibition is again to be devoted to the work of Apprentices and Learners, in competition, and the Councils of the Physical Society and Optical Society have appointed the following Judges :—Dr. C. V. Drysdale, Professor A. F. C. Pollard, Sir Thomas Stanton and Mr. William Taylor.

We understand that invitations to the Exhibition have been sent to the Institution of Electrical Engineers, the Institution of

Mechanical Engineers, the Royal Aeronautical Society, the Royal Meteorological Society, the Faraday Society, and a number of other Societies and Bodies. As in previous years, members of these Societies should apply for tickets to their Secretaries. Others may obtain tickets on application to the Secretary, the Physical and Optical Societies, 1, Lowther Gardens, Exhibition Road, London, S.W.7. Tickets are required only on January 6 and 7. Admission on the third day, January 8, will be without ticket.

GEOLOGICAL SOCIETY OF LONDON.

December 3, 1930.

Professor E. J. GARWOOD, F.R.S., PRESIDING.

The following communication was read :

The Riss Glaciation in the South-Eastern Parts of England. By P. TESCH, Director of the Geological Survey of the Netherlands. (Communicated by Henry Dewey, F.G.S.)

The plains of Western Germany and Northern Holland and the North Sea Basin were covered by the ice-sheet of the Riss glaciation.

The Gunz ice-sheet kept close to the highlands of Scandinavia and the Alps : the Mindel ice may have reached the Elbe and the Weser, but it did not reach Holland, nor did the Würm ice-sheet.

In Holland and West Prussia the middle and high terraces of the lower Rhine basin are associated with the advance and retreat of the Rissian ice. In Holland the Pleistocene beds are from 1200 to 1800 feet thick, as at Amsterdam .

Short accounts of the fauna and flora of these beds are given in the paper : the following characteristic fauna of the Mindel-Riss interglacial beds is noted :—*Elephas antiquus, Rhinocerous merckii*, as well as other mammals, of minor importance. Land and freshwater mollusca are well represented, and the following, among others, constitute those of the horizon of *Viviparus diluvianus* :—*Valvata naticina, Bithynia tentaculata, Ancylus lascutris, Helix nem oralis, Helix arbustorum, Succinea oblonga, Sphærium corneum.*

A close conformity exists between the Dutch deposits and those of Norfolk; for, in both Holland and East Anglia, the detritus was derived from the Rhine and Meuse drainage-areas, but the East Anglian beds are not complete. In the succession from the Early Icenian up to the Cromer contorted drift there are many gaps caused by tectonic and eustatic changes of level: many of the anomalous fossils are probably derivations from older horizons. In Holland the horizon of *Viviparus diluvianus* is below the Riss glacial beds with their Scandinavian boulders, and the Author's submission is that, as it is only in the Rissian ice-sheet that such boulders occur, it is unlikely that the boulder-clay with Scandinavian erratics of East Anglia is of a different age.

NOTICES OF BOOKS.

Report of the Building Research Board for the Year 1929. Roy. 8vo.; paper wpr.; pp. vii + 116, with 34 figs. and diagrams. Department of Scientific and Industrial Research. Price 2s. 6d. net. Postage extra.

The fourth annual report of the Building Research Board provides a summary of the progress made during the calendar year 1929 in the section of the Department's activities devoted to Building and Constructional Science.

Contacts between the Building Research Station and the building industry are being maintained and strengthened and new links are being forged. A notable example of this is the liaison with the Steel Structures Research Committee recently appointed to investigate the possibilities of the more efficient and economic use of steel in buildings and bridges. An important part of the activities of the Building Research Station is the work which is being performed in connection with the formulation by the British Engineering Standards Association of standard specifications can scarcely be exaggerated; they provide guides to the producers, safeguards to the consumer and, very often, form the basis for future technical and economic progress.

Following the precedent of previous reports, the report of the Director of Building Research is again divided into two main sections :— " General Research and Special Investigations " and " Intelligence and Minor Investigations." Fundamental research in connection with the weathering of materials is progressing steadily and work in this section has received considerable impetus from the introduction of methods and ideas developed in connection with " Soil Physics." Considerable advance has been made in the study of the small movements which occur in concrete, and much has been done to elucidate stress conditions in reinforced concrete structural members which are the result of shrinkage and creep or flow under load. Significant, also, are the results of a study of the corrosion of steel in breeze and clinker concretes.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

36,204.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of acridine derivatives. December 1.

36,492.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of molybenum and carbonyl. December 3.

36,511.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of anthracene derivatives. December 3.

Specification Published.

838,854.—Dreyfus, N.—Manufacture of oxygenated organic compounds.

338,938.—Arnold, C. (Harshaw Chemical Co.).—Process and apparatus for the manufacture of chromium trioxide.

338,981.—I. G. Farbenindustrie Akt.-Ges. —Process for the manufacture of esters of phosphorus and phosphoric acid containing halogen.

Abstract Published.

336,628.—Halogenated fatty acids. (I. G. Farbenindustrie Ake.-Ges., Frankfort-on-Main, Germany).

Saturated of unsaturated fatty acids containing more than eight carbon atoms in the molecule, and which may contain hydroxy groups, are treated with halogens or a mixture of a chlorate and hydrochloric acid, whereby at least three halogens enter the molecule, one at least of which replaces a hydrogen atom by substitution. According to examples, trichlorinated, tetrabrominated and hexachlorinated- ricinoleic acid and a trichlorinated oleic are thus obtained by direct halogenation. A pentachlordikydroxy stearic acid is also obtained by direct treatment of the parent substance with chlorine. In further examples, a solution of ricinoleic acid in carbontetrachloride is treated with chlorine, while cooling, until a product containing 16 atoms of chlorine in the molecule is obtained. A heptachlorinated ricinoleie acid, a tetrachlorinated oleic acid and a hexachlorinated stearic acid are similarly obtained, using carbontetrachloride solutions of the parent fatty acids. The chlorination of stearic acid, by potassium chlorate and introducing gaseous or aqueous hydrochloric acid is also referred to. The products are oils, generally having adhesive properties, or plastic or resinous substances.

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